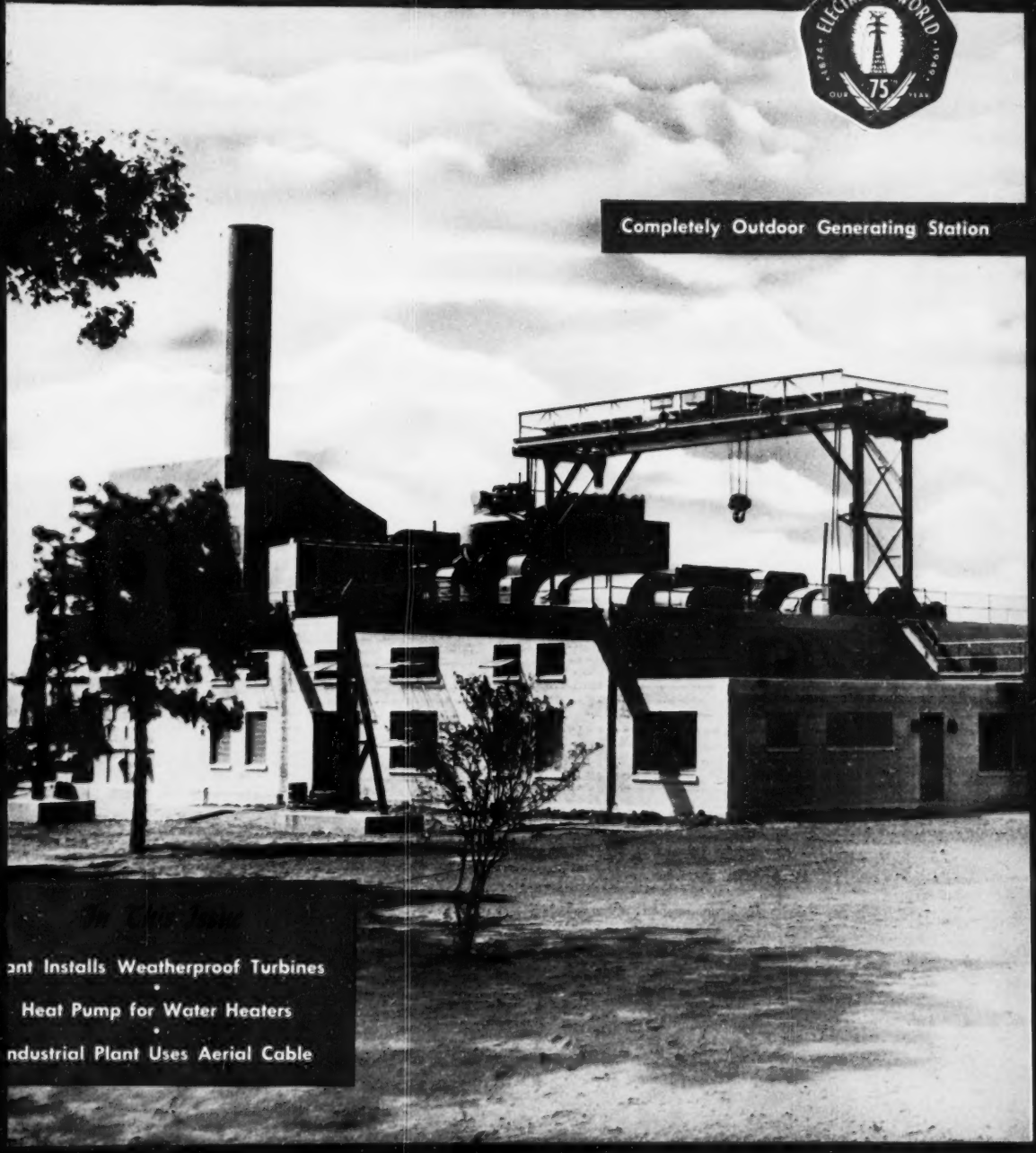
ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

FEBRUARY 26, 1949



Completely Outdoor Generating Station

In This Issue

ant Installs Weatherproof Turbines

Heat Pump for Water Heaters

ndustrial Plant Uses Aerial Cable

NEW WESTON

MODEL 901 SERIES
A-C AND D-C PORTABLES

the modern concept

in **READABILITY...**

in **SHIELDING!**

Designed...and styled...to bring you Weston's concept of the finest general purpose portables ever produced! These instruments are offered with full assurance that their dependability will reflect credit upon the name they bear. Write for Circular A-22-A. Weston Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, N. J.

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ELECTRICAL WORLD

Published for 75 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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COVER PICTURE—New Coughlin Station, Central Louisiana Electric Co, uses outdoor turbines on the roof. Two 7,500-kv generators are driven by 600 psi gage 825 F turbines. Station operating room is underneath.

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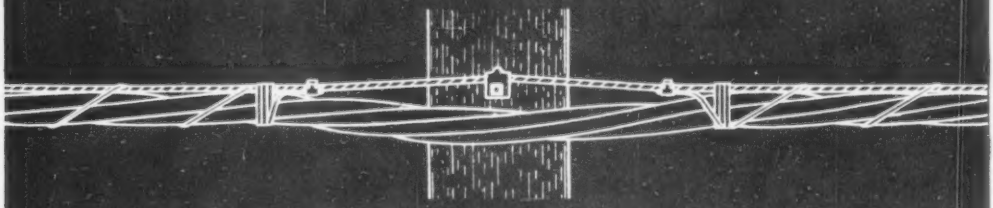

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...the storm-safe, low-cost improvement over open wiring

Insulated aerial power cables time and time again have reduced circuit outages during sleet storms, floods and hurricanes. They require no attention under such conditions. When insulated aerial power cables are used for important feeder or vital overhead sections, storm repairs on main circuits are avoided and linemen can direct immediate efforts toward getting service reestablished for essential customers.

Okolite-Okoprene Self-Supporting Aerial Cable with in-built messenger is a cable assembly that can be installed in a single operation . . . no separate stringing of messenger or placing of rings. It is widely used for overhead lines, for industrial services, circuits between buildings and for indoor use supported from beams and trusses. Okonite's patented "Dualay" assembly permits tapping "hot" on lines operating up to 5000 V.

A 52-page manual, Bulletin EW-1033 gives you pictures, figures and facts about Okolite-Okoprene Self-Supporting Aerial Cable. Here is complete engineering information . . . sag and tension data . . . current carrying capacities . . . ice and wind loadings, page after page of photographs and diagrams of installation, tapping, splicing. For a copy, write on your business letterhead to The Okonite Company, Passaic, N. J.

REDUCES OUTAGES DURING STORMS

THE BEST CABLE IS YOUR BEST POLICY

OKONITE SINCE 1878 *insulated wires and cables*

7280

SAVE TIME *and* TROUBLE

with *Electroline* products for

- **SPLICING**
- **DEAD ENDING**
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EVERY one of these power line products was originated by Electroline . . . and has won lasting reputation with Power Men everywhere for ease of installation, dependability and slashing maintenance costs. If you don't already know them, investigate this family of power line products developed by Electroline . . . Always ahead of the field! Bulletins sent on request.

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5 of the 8 LARGEST Utilities *Have Already*

The Positect is a "3-in-1" protective unit of unique and superior character. As a distribution cutout it tops the list in interrupting capacity and dependability. But the new Positect is more than a cutout, since it embodies safety and convenience features of great importance, not heretofore expected of any cutout.—And it provides these features at a cost so low that it permits widespread use—even standardization for the entire system.

Here enumerated are the features that make the Positect outstanding:

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- Up to 12,000 RMS amperes—the highest of any cutout.
- Invulnerability to corrosion, vibration, and interference from ice, bugs or birds; adequate mechanical strength and high flashover values exceeding NEMA standards by up to 60%—all of which tend to assure highest interrupting ability at all times.

(2) SWITCHING CONVENIENCE

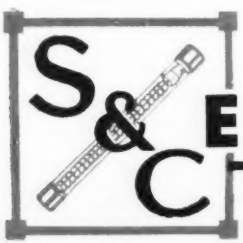
- Insertion or withdrawal of handle-and-tube is all that is necessary for switching distribution transformer load or magnetizing currents, or charging currents of small capacitor banks.

(3) SAFETY CHARACTERISTICS

- Removes the hazard attending the inadvertent opening of conventional cutouts under load.
- Discharge is away from the man if accidentally closed in on short circuit.
- All live parts are unusually well enclosed.
- High interrupting ability gives adequate margin of safety against cutout "blowing up".

These features make the Positect particularly desirable for application on metropolitan distribution systems where concentration of power is a general condition; for the areas of any system where power is concentrated; and for the growing areas where ultimately load concentration will bring about excessively high short circuit currents.

The fact that 5 of the 8 largest electric utilities have already adopted the Positect may be significant that it is a product meriting *your* most serious consideration. Ask for Catalog Section 520 telling more of the story.



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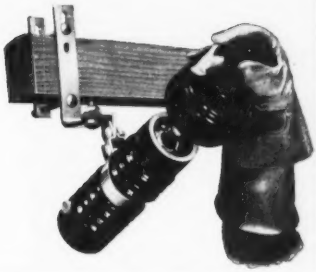
Adopted the NEW POSITECT



TYPICAL PERFORMANCE VALUES

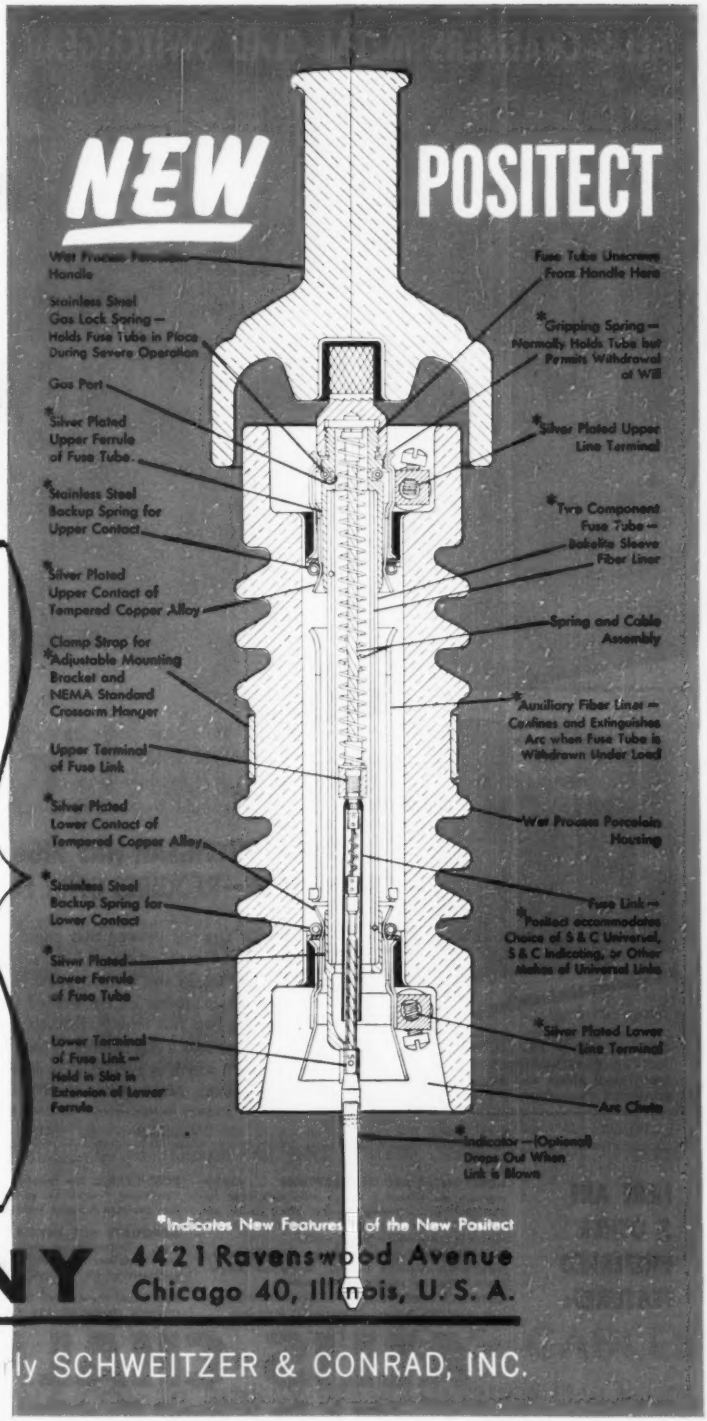
Short Circuit Interrupting Capacity
of 10,000 and 12,000 amperes for the 50-ampere and 100-ampere Positect respectively, on 2400-, 2400/4160y- and 4800-volt systems.

Load and Magnetizing Current Interrupting Ability
adequate for switching: 75 kva single-phase distribution transformers on 2400- and 2400/4160y-volt systems, with the 50-ampere Positect; 100 kva single-phase, with the 100-ampere Positect; also 3-phase transformers of corresponding load current values.

Charging Current Interrupting Ability
adequate for switching 3-phase capacitor banks up to 135 kvar on 2400-volt systems, and 225 kvar on 2400/4160y-volt systems, with 50-ampere Positect; with the 100-ampere Positect, 225 kvar on 2400-volt systems.

RATINGS

5000 Volts, 50 Amperes
5000 Volts, 100 Amperes
7500 Volts, 50 Amperes


Wet Process Porcelain Handle
Stainless Steel Gas Lock Spring — Holds Fuse Tube in Place During Severe Operation
Gas Port
*Silver Plated Upper Ferrule of Fuse Tube
*Stainless Steel Backup Spring for Upper Contact
*Silver Plated Upper Contact of Tempered Copper Alloy
Clamp Strap for *Adjustable Mounting Bracket and NEMA Standard Crossarm Hanger
Upper Terminal of Fuse Link
*Silver Plated Lower Contact of Tempered Copper Alloy
*Stainless Steel Backup Spring for Lower Contact
*Silver Plated Lower Ferrule of Fuse Tube
Lower Terminal of Fuse Link — Held in Slot in Extension of Lower Ferrule
Fuse Tube Unscrews From Handle Here
*Gripping Spring — Normally Holds Tube but Permits Withdrawal at Will
*Silver Plated Upper Line Terminal
*Two Component Fuse Tube — Bakelite Sleeve Fiber Liner
Spring and Cable Assembly
*Auxiliary Fiber Liner — Confines and Extinguishes Arc when Fuse Tube is Withdrawn Under Load
Wet Process Porcelain Housing
Fuse Link — *Positect accommodates Choice of S & C Universal, S & C Indicating, or Other Makes of Universal Links
*Silver Plated Lower Line Terminal
Arc Chute
*Indicator — (Optional) Drops Out When Link is Blown

*Indicates New Features of the New Positect

COMPANY

4421 Ravenswood Avenue
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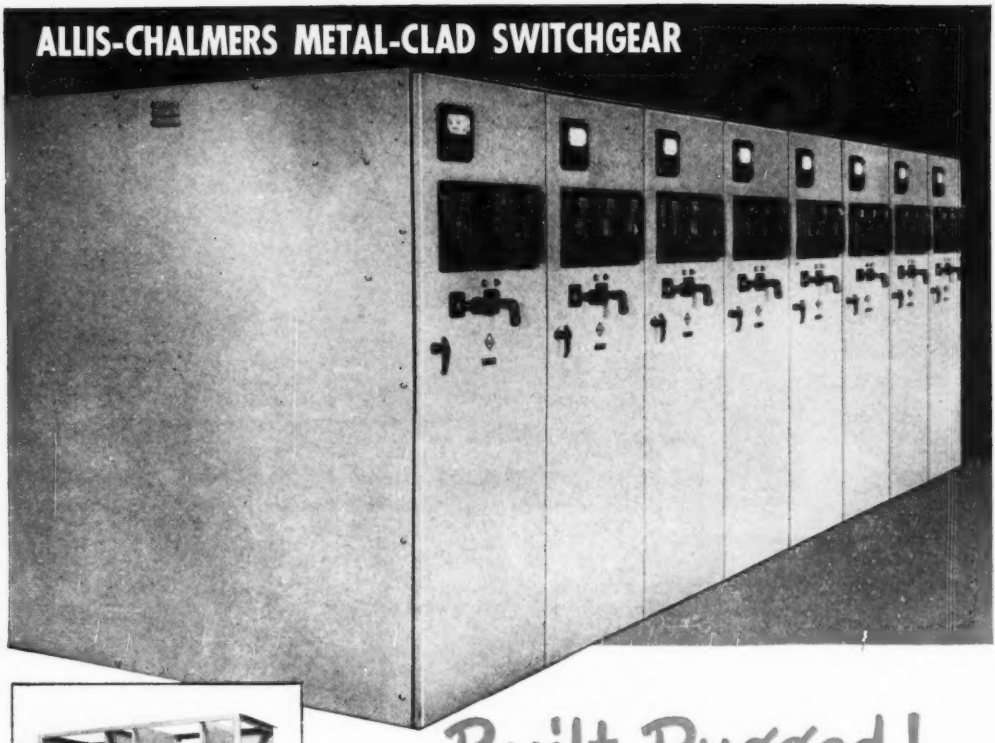
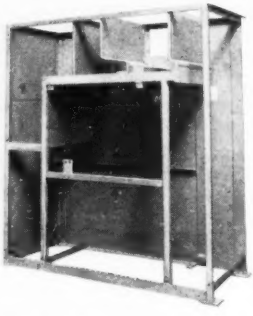
Formerly SCHWEITZER & CONRAD, INC.

ALLIS-CHALMERS METAL-CLAD SWITCHGEAR





THIS STRONG FRAMEWORK really *protects* switchgear . . . heavy steel plates and angles are reinforced throughout.

Built Rugged!

A-C SWITCHGEAR HAS RIGID, SELF-SUPPORTING STRUCTURE—REQUIRES ONLY FOUR POINT ALIGNMENT!

A RECENT SURVEY showed that engineers were most impressed with the rugged construction of A-C switchgear. Here's why: the framework of steel angles and formed plates is reinforced to make a self-supporting structure; joints are lap welded for extra strength, structures are assembled on two full length channels for simple, four point support.

This kind of sound engineering is reflected throughout all A-C switchgear . . . that's why it is *preferred* by operating men and engineers alike. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2502

Ruptair, Ruptor are Allis-Chalmers trademarks.

HERE ARE 5 OTHER PREFERRED FEATURES:

HORIZONTAL ARC INTERRUPTION . . . *Ruptair* magnetic air circuit breakers eliminate need for "puffers" . . . natural thermal effect assists arc into the arc chute. Especially effective at low currents when magnetic effect is weak.

A-C DESIGNED arcing contacts of high melting point alloys minimize burning, assure low maintenance, long life under repetitive duty.

CONTACT FINGERS on removable element permits easy inspection without de-energizing main bus.

PREDICTABLE low installation costs . . . unit is "packaged," ready for connection. Detailed drawings provided for each installation.

ADEQUATE BUS INSULATION . . . no-corona tape, bakelized paper tubing, insulating tape eliminate compound-filled joints. Easily installed in field and removed for installation changes.

A-C builds these circuit breakers: Air Blast, *Ruptair* magnetic, *Ruptor* oil, Low Voltage air.

ALLIS-CHALMERS

First in the U. S. with Metal-Clad Switchgear

FOR FAILURE-FREE CIRCUITS IN WET LOCATIONS

INSTALL

ANHYDREX

CABLES

Wherever water or moisture menace electric circuits it's a wise move to install Simplex-ANHYDREX Cables. ANHYDREX Cables have what it takes to provide uninterrupted service, year after year, in wet locations. And "what it takes" is nothing less than the well-known Anhydrex insulation.

Anhydrex insulation has proved itself, in all types of installations, to have a low rate of water absorption. It is low when cables are first put into use and it stays low even though they are submerged for years. This resistance to interference by water and moisture, plus the protection against sunlight and foul weather, heat, soil acids and alkalies provided by an outer jacket of neoprene, is your assurance of dependable and economical power, signal, and control systems.

It means that ANHYDREX Cables are equally suitable for underground, duct, or aerial installations; that you need buy only one type of cable for all three services. It means years of trouble-free performance, low maintenance costs and few replacements.

The Simplex representative in your area will be glad to give you complete information and help you choose the ANHYDREX Cables that best fit your specifications.

Simplex

WIRES & CABLES

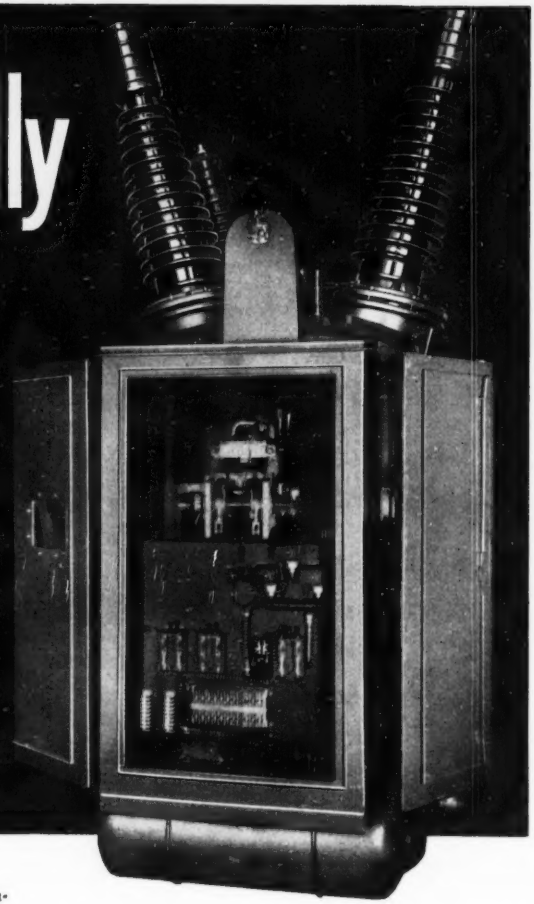
SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

Mechanically Trip-Free

PNEUMATIC OPERATOR

MEANS BEST PROTECTION FOR YOUR EQUIPMENT

INSTANT BREAKER OPERATION UNDER ALL FAULT CONDITIONS



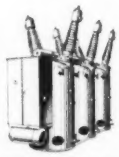
MECHANICALLY TRIP-FREE action instantly releases contacts from closing force when closed on a fault . . . permits high contact acceleration unhindered by closing cylinder back-pressure or toggle inertia. You get instant, complete contact opening under all tripping conditions.

With this powerful Allis-Chalmers electro-pneumatic operator, highest possible system stability and service continuity are maintained. The breaker cannot be held closed on a fault . . . and operator mechanism is quickly recoupled to permit fast reclosing—within 20 cycles. Pneumatic operation furnishes reliable, high-speed contact closing economically — requires only fractional horsepower motor.

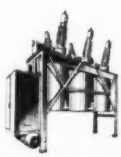
This *mechanically trip-free* electro-pneumatic operator is just one of many features you get on Allis-Chalmers oil circuit breakers. For details on any rating, contact your nearby A-C representative. Or write direct. A 2625

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

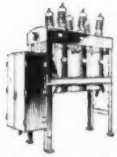
IT'S STANDARD EQUIPMENT ON THESE ALLIS-CHALMERS OIL CIRCUIT BREAKERS



TYPE BZO-160 . . . 69 to 230 kv — 3- or 5-cycle opening, 20-cycle reclosing



TYPE FZO-151 . . . 69 kv . . . frame-mounted—5- or 8-cycle opening, 20-cycle reclosing.



TYPE FZO-150 . . . 15 to 46 kv—8-cycle opening, 20-cycle reclosing

ALLIS-CHALMERS

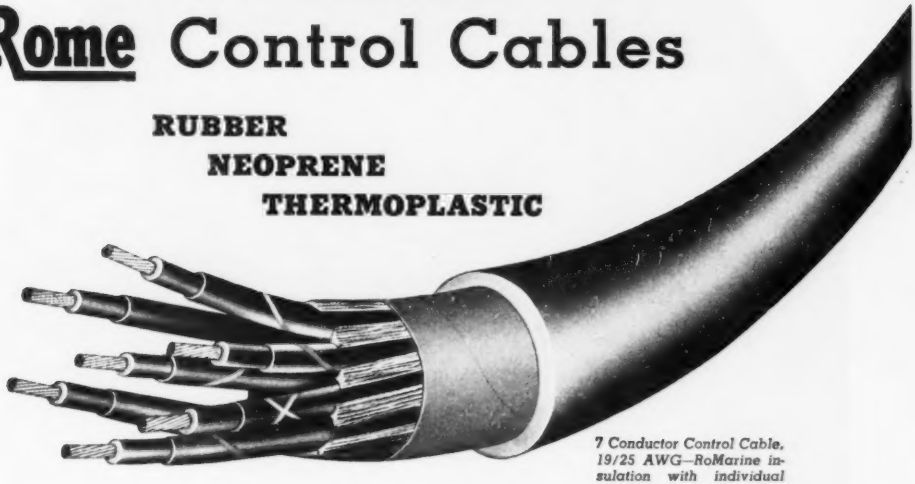
Pioneers in Power and Electrical Equipment from Generation through Utilization

TO ELIMINATE CONTROL CIRCUIT FAILURE...

Specify

Rome Control Cables

RUBBER
NEOPRENE
THERMOPLASTIC



7 Conductor Control Cable, 19/25 AWG—RoMarine insulation with individual conductor sheath of Neoprene—RoPrene (Neoprene) sheath over all—600 Volts.

Protect those vital control circuits . . . the "nerve system" of your whole distribution network . . . with the dependability of Rome Control Cables. You can ill afford the loss of revenue and customer good will when outages occur from control circuit failure. As a matter of fact there is no need to run that risk. Rome Control Cables are manufactured to one standard of quality . . . the highest . . . and carry with them a sense of responsibility for dependable and unfailing service.

In Rome Control Cables, too, you will find variety of construction to meet your particular requirements. In the design of individual conductor insulation, as well as outer protective sheath, Rome Synthinol* thermoplastic, rubber, and Neoprene compounds can be combined, or used separately, to provide the ultimate in service performance. Typical Control Cable constructions are described in Specifications **CT-1, CRM-1** and **CRO-1.** Write for your copies today.

* TRADEMARK REGISTERED

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION
ROME • NEW YORK

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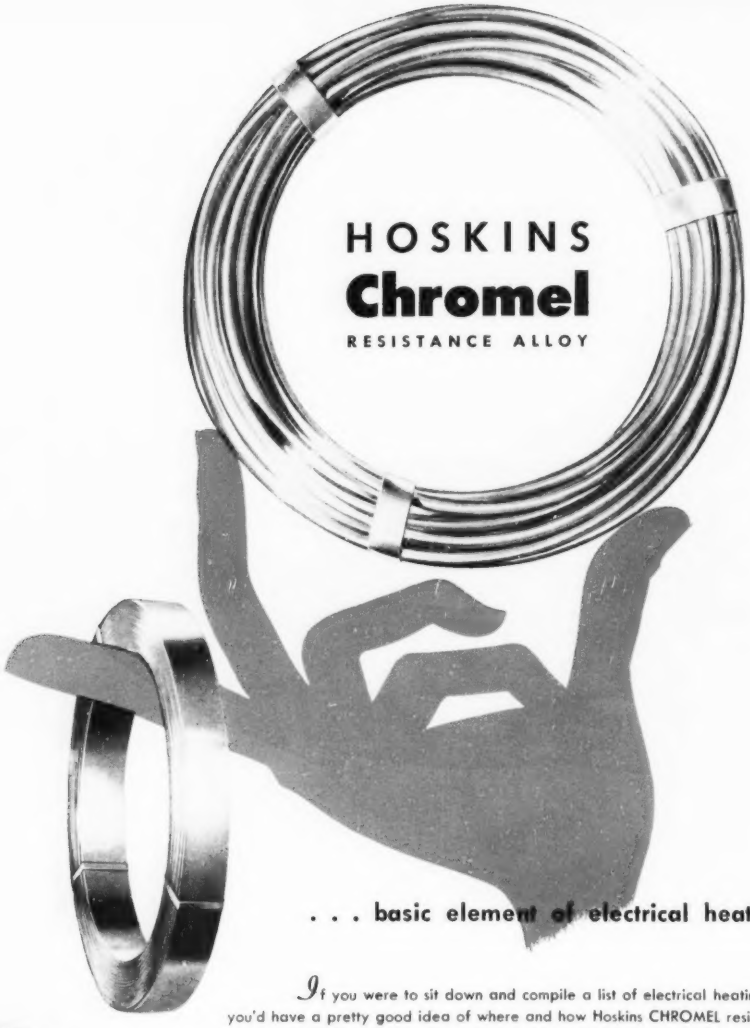


. . . basic element of electrical heating

If you were to sit down and compile a list of electrical heating applications, you'd have a pretty good idea of where and how Hoskins CHROMEL resistance alloy is used. For CHROMEL, you know, is the *original* nickel-chromium alloy that *first* made electrical heating practical. It's ductile, durable stuff . . . easy to work with, hard to burn out. Possesses close-to-constant "hot" resistance between 700° and 2000° F. Delivers full-rated power throughout its long and useful life. And, for over 40 years, it's been used consistently and with confidence by leading manufacturers of all types of electrical resistance heating devices. So if you're concerned with electrical heating . . . from a utility load building point of view, as a manufacturer of appliances, or as a user of electric heat in your manufacturing processes . . . your best interests can best be served by Hoskins CHROMEL wire, ribbon or rod. Our Catalog M-1 contains complete technical information . . . want a copy?

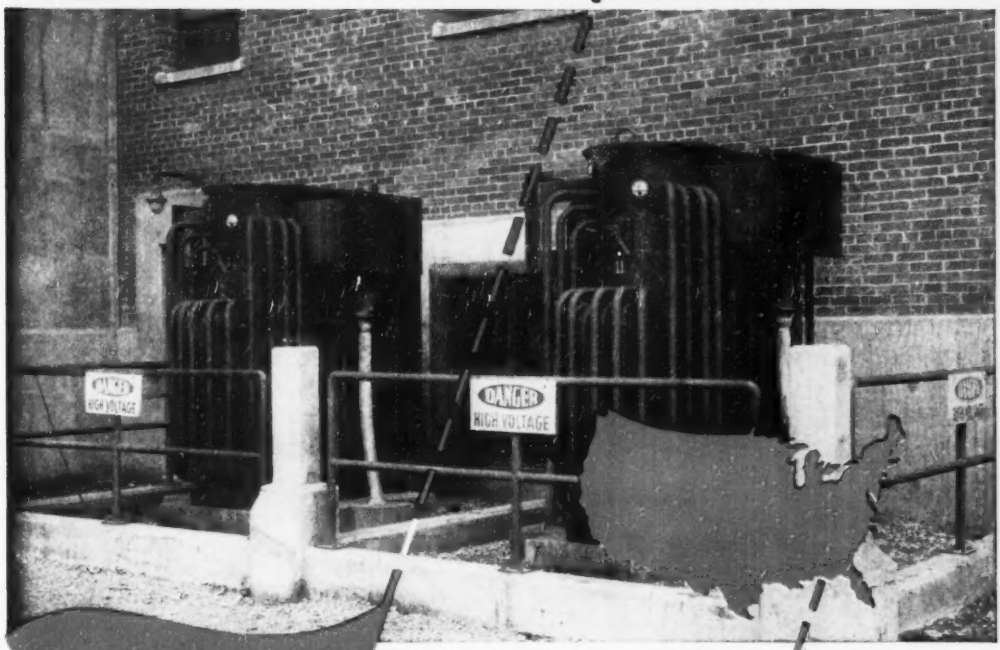
HOSKINS MANUFACTURING COMPANY
4445 LAWTON AVE. • DETROIT 8, MICHIGAN

Heating Element Alloys ★ Heat Resistant Alloys ★ Thermocouple Alloys ★ Spark Plug Electrode Wire ★ Special Alloys of Nickel ★ Electric Heat Treating and Laboratory Furnaces

Standard TRANSFORMERS

TRADE MARK

Here are two STANDARD type AT, 450 KVA, 2400 volts, three phase, 60 cycle transformers . . . with high and low voltage terminal chambers, equipped with pot heads for cable connection.



ON THE JOB Standard Transformers offer

6

ADVANTAGES

- trouble-free performance
- safety
- long life—dependability
- economical operation
- high efficiency
- attractive appearance

The life and dependability of your transformers depend upon the materials which go into their making. More than that, STANDARD transformers are engineered and built to fulfill special requirements of each job. They are available in capacities up to 10,000 KVA, self cooled, and voltage ratings up to 69,000 inclusive. These are the reasons STANDARD transformers dot the map of the United States in a dense pattern . . . serving industrial plants, municipalities, mines, and utilities everywhere. For complete information on engineering and construction features, write today. You will see quickly why STANDARD transformers are economical and dependable to own and operate.

THE STANDARD TRANSFORMER CO.

WARREN • OHIO

MAKERS OF POWER, DISTRIBUTION, INSTRUMENT, STREET LIGHTING AND TESTING TRANSFORMERS • • OIL, ASKAREL OR AIR COOLED

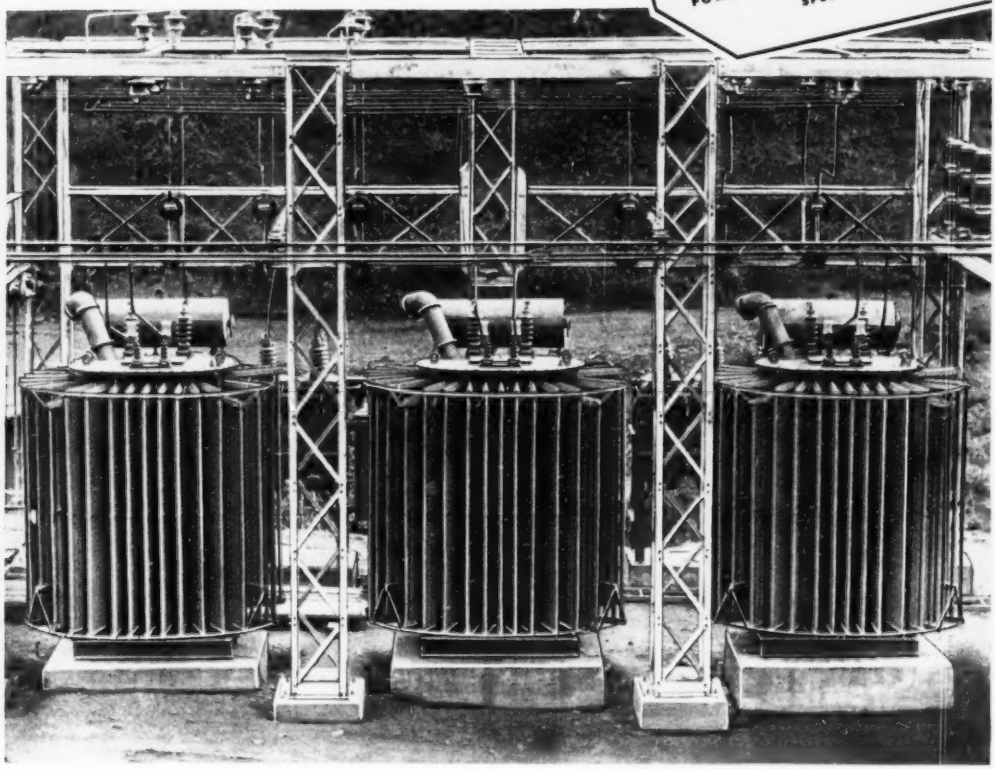
Offices in Principal Cities

A DEPENDABLE Link

for Industrial Power Systems

Uptegraff TRANSFORMERS

POWER · DISTRIBUTION · INSTRUMENT SPECIALTY



The three 5,000 KVA Uptegraff Power Transformers shown above, serving an industrial plant in West Virginia, are 33,000 volt, 60 cycle, single phase, oil-immersed, self-cooled units.

Uptegraff offers a complete line of transformers for indoor or outdoor service, with sizes from 1/10 to 10,000 KVA. Types include: Power, Distribution (both dry type and liquid cooled), Instrument and Specialty.

We can quickly meet your needs with dependable transformers designed and built to your specifications.

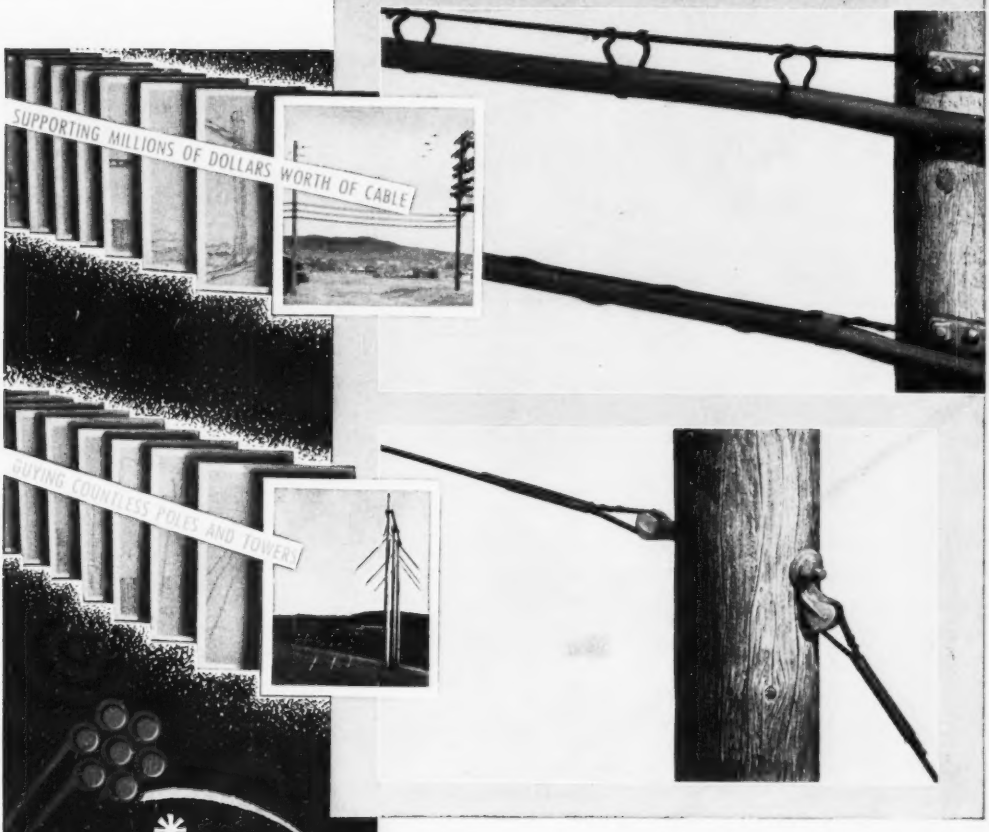
R. E. UPTEGRAFF MANUFACTURING CO. SCOTTDALE, PENNSYLVANIA

Copperweld NON-RUSTING* Strand

TRADE MARK

Has Proved Its Value

ON THOUSANDS OF MILES OF LINES



* Copperweld Strand is Permanently Protected against Corrosion. Each Wire has a thick Copper Covering inseparably Molten-Welded to a strong Alloy Steel Core.

The permanence of Copperweld Strand, demonstrated in severe service during the past thirty years, has earned the confidence of the entire industry. For long-lasting guys and messengers, you can't beat this reliable, time-tested strand.

And it's sound economics to use non-rusting Copperweld Strand because you save by eliminating replacement costs. With Copperweld you don't need to buy oversized strand as a protection against later loss of strength caused by rust. Copperweld Strand can't rust—its original strength is permanent.

Write for Engineering Data

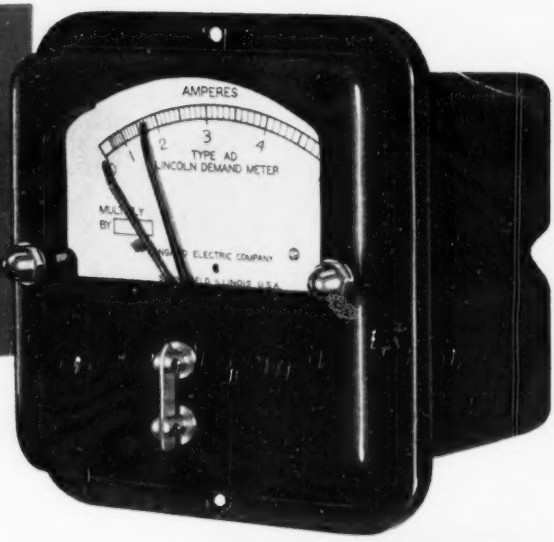
COPPERWELD STEEL COMPANY

GLASSPORT, PA.

SALES OFFICES IN PRINCIPAL CITIES

MEASURE *the factor which determines the capacity of Substation Feeders*

with
LINCOLN
Type AD-2
Ampere Demand Meters

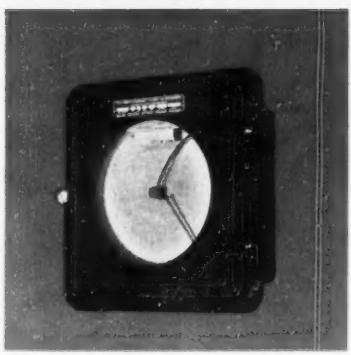


Lincoln Type AD-2 Thermal Type Ampere Demand Meters measure the factor which determines the capacity of substation feeders, and are particularly useful in balancing the demand between phases to get the most out of system and distribution capacity.

These meters are equipped with two demand indicating pointers. One is attached to the actuating element of the motor and shows the demand on the feeder phase at all times, while the other shows the maximum demand established since the last manual resetting.

Now available in attractive semi-flush mounting, they are especially designed to fit into the same punched aperture as provided for indicating ammeters of modern design.

Write for Bulletin No. 462. It gives complete information.

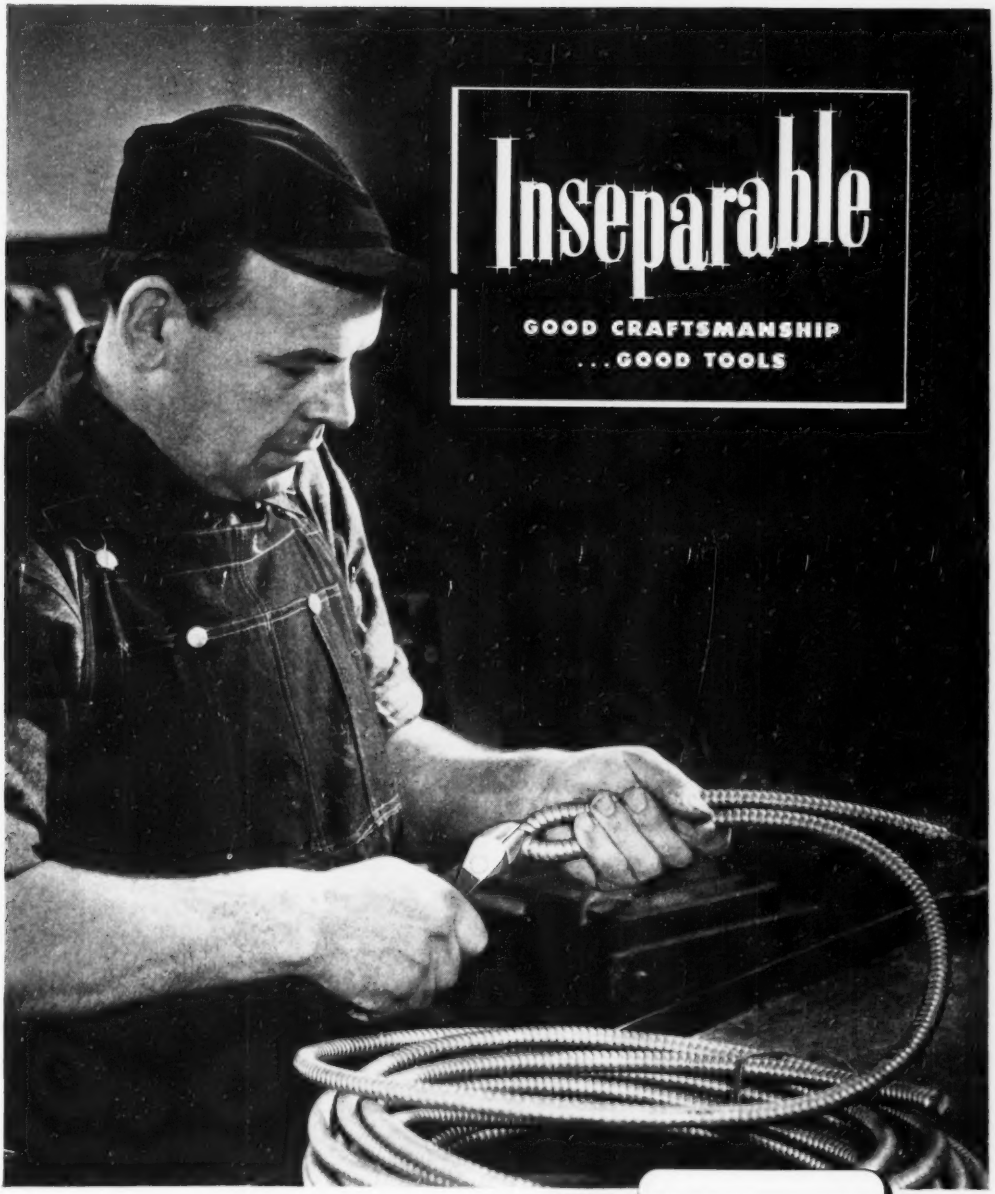


Lincoln Graphic Demand Meters for Semi-Flush Mounting

Available in Graphic Form for Ampere, Watt or KVA Demand, where a record is required. Bulletins No. 450 and 452 give complete information.

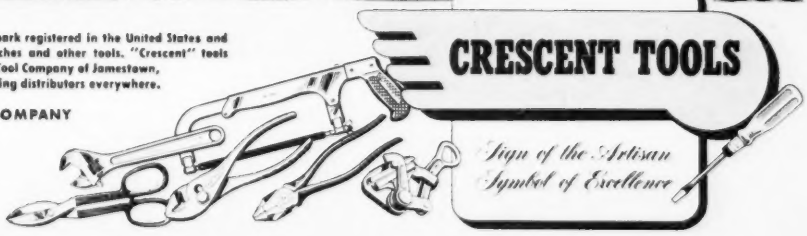
50TH ANNIVERSARY 1899 - 1949

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS



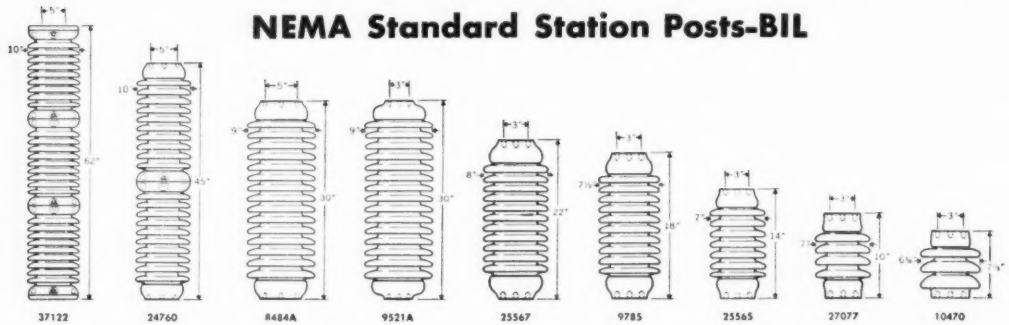
"CRESCENT" is our trade-mark registered in the United States and foreign countries for wrenches and other tools. "Crescent" tools are made only by Crescent Tool Company of Jamestown, N. Y., and are sold by leading distributors everywhere.

CRESCENT TOOL COMPANY
Jamestown, N. Y.



Announcing...

NEMA Standard Station Posts-BIL

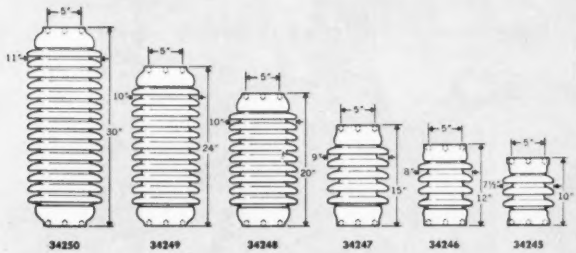


CATALOG NUMBER	37122	24760	8484A	9521A	25567	9785	25565	27077	10470
Rating, kv	161	115	69	69	46	34.5	23	15	7.5
Dry Flashover Voltage, kv	485	385	235	235	170	145	110	85	60
Wet Flashover Voltage, kv	380	285	180	180	125	100	75	55	40
Impulse Flashover Voltage, kv, Pos. 1.5 x 40	800	590	390	390	280	225	170	125	105
Impulse Flashover Voltage, kv, Neg. 1.5 x 40	1000	770	475	475	340	290	250	200	120
Leakage Distance, inches	132	99	72	72	43	37	24	15.5	10.5
Cantilever Strength, upright, lbs.	1200	1700	1500	1500	2000	2000	2000	2000	2000
Cantilever Strength, inverted, lbs.	1070	1470	1500	1500	2000	2000	2000	2000	2000
Tension Strength, lbs.	20000	20000	12000	12000	8000	7000	5000	5000	5000
Torsion Strength, inch-lbs.	40000	40000	15000	15000	12000	10000	8000	7000	6000

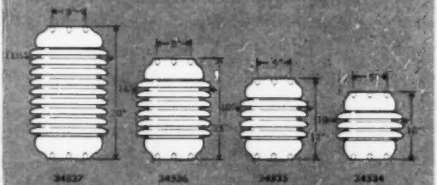
Now available for the first time as "catalog items" are Lapp Station Posts in complete series standardized in three strength ratings. These insulators are in accordance with BIL established values and meet NEMA standards. When you standardize on Lapp Station Posts for switch and bus support, you assure yourself insulators soundly engineered to every service requirement. Lapp NEMA Standard Station Posts, High-Strength Station Posts, Extra-High-Strength Station Posts, and a variety of special-purpose Station Posts, are listed, together with complete specifications, in the new Lapp Catalog No. Seven. If you have not received your copy, we will send it on request. Lapp Insulator Co., Inc., LeRoy, N. Y.

LAPP STATION POSTS IN 3 STRENGTH SERIES

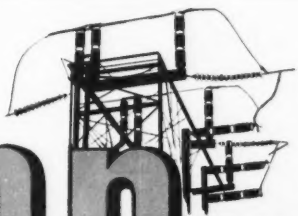
High-Strength Station Posts-BIL



Extra-High-Strength Station Posts-BIL



CATALOG NUMBER	34250	34249	34248	34247	34246	34245	34537	34536	34535	34534
Rating, kv	69	46	34.5	23	15	7.5	34.5	23	15	7.5
Dry Flashover Voltage	235	170	145	110	85	60	145	110	85	60
Wet Flashover Voltage	180	125	100	75	55	40	100	75	55	40
Impulse Flashover Voltage, kv, Pos. 1.5 x 40	390	280	225	170	125	105	225	170	125	105
Impulse Flashover Voltage, kv, Neg. 1.5 x 40	475	340	290	250	200	120	290	250	200	120
Leakage Distance, inches	72	43	37	24	15½	10½	37	24	15½	10½
Cantilever Strength, upright, lbs.	4000	4000	4000	4000	4000	4000	8000	8000	8000	8000
Cantilever Strength, inverted, lbs.	4000	4000	4000	4000	4000	4000	8000	8000	8000	8000
Tension Strength, lbs.	20000	15000	14000	10000	10000	10000	28000	20000	20000	20000
Torsion Strength, inch-lbs.	40000	20000	20000	16000	14000	12000	40000	32000	28000	24000



Lapp INSULATORS

In the home, too . . .

MALLORY ELKONITE* CONTACTS

Mean a Flip of a Switch Instead of a Hunt for a Fuse

Out go the lights! A "short"! Once it meant a mean trip to the cellar fuse box—often to find that the right fuse was missing. Now, in more and more homes, it simply means a flick of a nearby switch.

Equipped with Mallory-developed Elkonite Contacts, circuit interrupters have brought this new convenience. This same Elkonite is the contact material used in circuit breakers of giant power plants. Elkonite that served one of the world's largest test circuit breakers—at Grand Coulee—which interrupted 7½ *million kva*, more than twice the kva load of any breaker now in service.

With the protection of thousands of homes—and giant power stations—at stake, the circuit breaker contact has a huge responsibility. And Mallory Elkonite is equal to it. Made by a special process, Elkonite features hardness, conductivity, resistance to wear and impact, erosion by arcing, and sticking. It is one of many types of Mallory contact materials that meet wide applications.

What's Your Problem?

In fact Mallory has designed so many types that even if your problem is unusual, chances are that Mallory has a standard contact to meet it. If not, Mallory engineers are equipped to develop the precise one for you. Consult them now!

For all kinds of contact materials and service, you can't beat Mallory as a dependable, experienced source.

In Canada, made and sold by Johnson, Matthey & Mallory, Ltd., 110 Industry St., Toronto 15, Ontario.

Electrical Contacts and Contact Assemblies

P. R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Capacitors	Rectifiers
Contacts	Switches
Controls	Vibrators

Power Supplies

Resistance Welding Materials

*Reg. U. S. Pat. Off.

You'll Save . . .

You'll Get Faster Deliveries with *Pennsylvania*

STANDARD PARTS POWER TRANSFORMERS

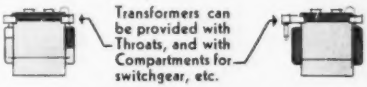
Available in the following sizes:

Three Phase: Up to 10,000 Kva, 34 Kv
Single Phase: Up to 5,000 Kva, 34 Kv

This new line of Pennsylvania Power Transformers was designed to include the desirable features of custom-built transformers, at quantity production prices. Streamlined and standardized methods of manufacture, coupled with the use of standard designs and standard parts, shorten engineering and production time. This reduces the price of the transformer and shortens the delivery time.

Auxiliary tanks, in most cases, do not add to the projected floor area.

The Sealed Tank and Inert Gas Pressure Systems can be changed, in the field, to Inert Gas-Oil Seal, without difficulty and without changing any parts. Inert Gas Pressure System can also be changed to Sealed Tank.



Transformers can be provided with Throats, and with Compartments for switchgear, etc.

Standard Parts Transformers can be supplied with any method of oil preservation.

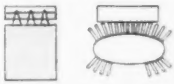
Auxiliary tanks, welded to each end of the transformer and connected to each other and to the main tank, form the following oil preservation systems:

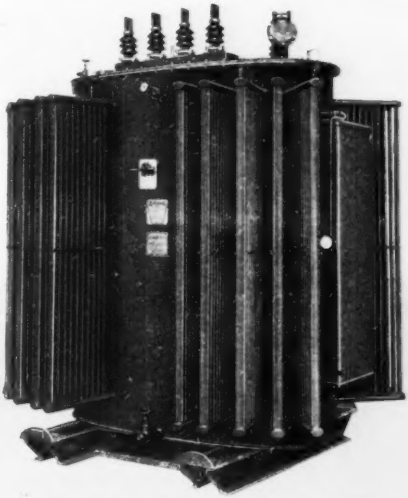
Inert Gas-Oil Seal

Sealed Tank

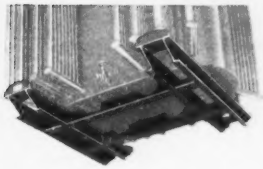
Inert Gas Pressure System

Oil expansion tank can be provided instead of auxiliary tanks.

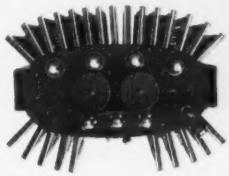




Standard Parts Power Transformer. 3750 Kva, 3 Phase, 60 Cycles, OA, 55°C. Voltage: 12,000 Delta-4,160 Y.



Base for Standard Parts Transformer. Base is designed to simplify jacking, pulling, rolling, and painting.



Top of 4000 Kva Standard Parts Transformer. Note how auxiliary tanks fit into ends of the transformer and do not add to the length of the transformer.

Pennsylvania TRANSFORMERS

For further information, write for Booklet No. 1492

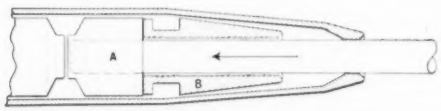
Pennsylvania
TRANSFORMER COMPANY
PITTSBURGH 12, PENNSYLVANIA

HERE'S BIG NEWS IN SPLICING

BURNDY SPLICIT with POSITIVE INITIAL GRIP!

A. The Positive Initial Grip

B. Full-Tension Gripping Jaw



Now two grips instead of one . . . the Positive Initial Grip and the Full Tension Gripping Jaw.

The Positive Initial Grip acts like a "head" on the wire . . . holding it initially until tension is applied. This Positive Initial Grip alone withstands a tension in excess of 100 lbs. The wire cannot be twisted out of the Positive Initial Grip, for it turns freely with the wire.

The Full Tension Gripping Jaw takes over as tension is applied, permanently gripping the wire for the full length of the jaw and thus developing and maintaining the full holding power. A *Positive Splice* every time.

Size for size the Splicit is smaller, lighter, more compact . . . fully enclosed against weather attack and dirt or grit.

You'll like the new SPLICIT. Samples may be obtained through your local Burndy representative or direct. Available in sizes for Nos. 6, 4, and 2 solid. Other sizes to follow.

Connect with

BURNDY

New York 54, N. Y.

WESTERN BRANCH: Vernon 11, California • CANADA: Canadian Line Materials, Ltd., Toronto 13

FOREIGN: Philips Export Corp., New York 17, N. Y.

Here's the Stored-Energy Mechanism in a 7.2 kv Oil Circuit Breaker

Outdoor Type AKE-25
7.2 kv, 600 amp
50,000 interrupting kva

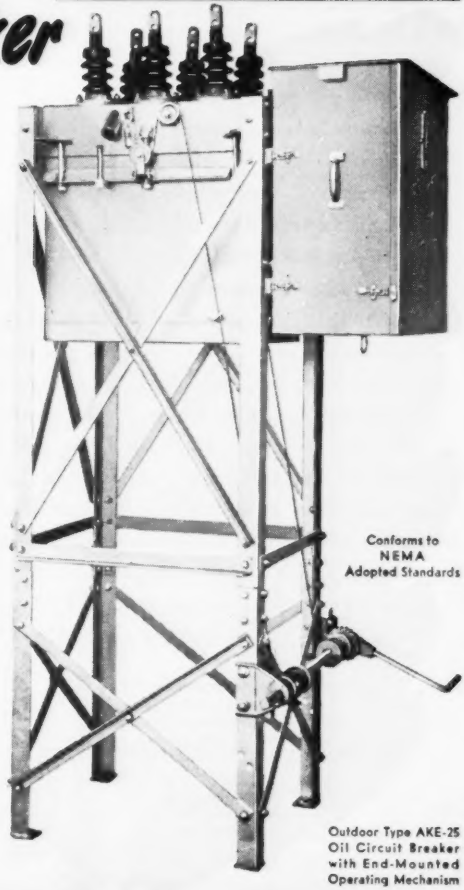
A Protective Unit with High-Speed, 3-Reclosures, completely tested and assembled . . . ready to operate.

Low Operating Current—The Motor-Compressed-Spring Mechanism uses only a **small** motor to compress the closing spring. May be a-c or d-c.

Simple Tripping Schemes—Though d-c potential trip provides the utmost in accuracy and reliability, many conditions permit use of a-c series trip with or without overcurrent relays. If a-c is used for the spring-compressing motor, the ultimate in simplicity and low cost is attained.

Rapid Arc Extinguishment—The Pacific Electric Mfg. Corporation exclusive Expulsion Chamber extinguishes the arc with a minimum of oil carbonization or effect on contacts.

Get All Facts . . .



Conforms to NEMA Adopted Standards

Outdoor Type AKE-25 Oil Circuit Breaker with End-Mounted Operating Mechanism

Call **PACIFIC ELECTRIC MFG. CORPORATION**

5815 THIRD STREET, SAN FRANCISCO 24, CALIFORNIA • P. O. BOX 419, GARY, INDIANA

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EDGAR F. HUBERT CO., 510 Statler Bldg., Boston 16, Mass.
ORMONDE SMITH, JR., 3842 Palm Ave., Houston 4, Texas

Other Representatives in Principal Cities

Your answer to Tube Dezincification–

ANACONDA ARSENICAL ADMIRALTY 439

ANACONDA began commercial production of Arsenical Admiralty Condenser Tubes in 1934—after two years of intensive research work. Tests had proved that a small percentage (0.04) of arsenic added to Admiralty Alloy materially increased its resistance to dezincification.

Since 1934, this improved alloy has performed outstandingly in almost every kind of service. Arsenical Admiralty Alloy 439 offers high heat transference as well as high resistance to general corrosion. It costs the same as plain Admiralty.

There are 8 standard and several special Anaconda Alloys for condenser and heat exchanger tubes. You are invited to consult our Technical Department in determining the most suitable alloy for your use. For general information on Anaconda Tubes and Tube Sheets, send for our Publication B-2.

ANACONDA
from mine to consumer

Anaconda

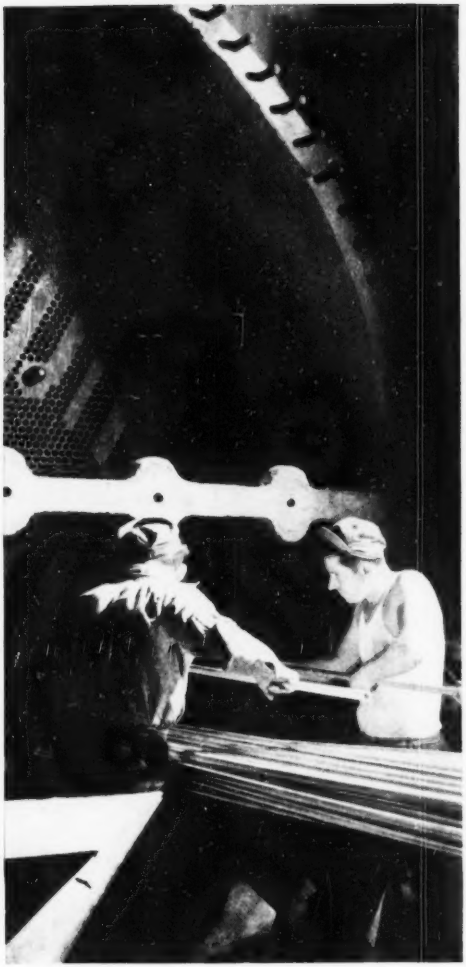
CONDENSER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*



Retubing with Arsenical Admiralty to Serve a New England Industrial Area

Arsenical Admiralty 439 Tubes were chosen for this recent retubing job, to combat the corrosive effects of a combination fresh and salt water coolant. The 2-pass condenser has a 29,000 sq. ft. cooling surface and serves a 25,000 kw generator. 5,600 tubes, with a weight of 65,000 lb, will go into the condenser. Utility station supplies power to an important New England industrial area.

linemen prefer it...

the clean treatment that is always clean

PENTACHLOROPHENOL for wood preservation

(Monsanto's Santophen 20)

Monsanto's Penta insures *clean wood* when properly applied. Linemen and superintendents prefer it because it does not bleed, regardless of weather conditions.

Cleanliness is only one of Santophen 20's many plus values... Its high toxic strength *is always constant*, always laboratory-controlled, assuring protection which is chemically determined and can be duplicated every time. No matter what preservative you are now using, it will pay you to investigate the advantages of Penta, Monsanto's Santophen 20, in protecting your investments in poles, crossarms and other treated wood. For full information, address MONSANTO CHEMICAL COMPANY, Desk A, Organic Chemicals Division, 1758 South Second Street, St. Louis 4, Missouri. *Santophen, Reg. U. S. Pat. Off.*

Low concentrations of Santophen 20 provide clean, dependable protection against wood-rotting fungi, termites and other wood-boring insects. The concentrations suggested below are based on a 5% solution of Santophen 20 in oil, in pounds per cubic foot of wood.

	CROSSARMS Min. Standards	POLES Min. Standards
In arid regions....	6 lb.	6 lb.
Where high moisture exists.....	6 lb.	8 lb.
For tropical service	8 lb.	12 lb.

MONSANTO
CHEMICALS — PLASTICS

MONSANTO CHEMICAL COMPANY
Desk A, Organic Chemicals Division
1758 South Second Street, St. Louis 4, Missouri

Please send me full information on Santophen 20 for preserving

Name_____ Title_____

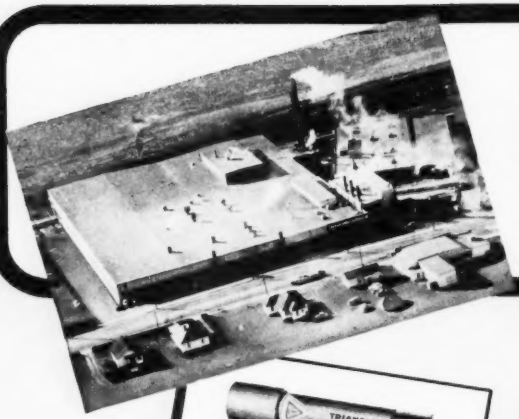
Company_____

Address_____

City_____ State_____

SERVING INDUSTRY . . . WHICH SERVES MANKIND

TRIANGLE'S NEWLY EXPANDED CONDUIT PLANT



Triangle Rigid Steel Conduit finish is hot dip galvanized, uniformly both inside and outside, with additional protection assured by a baked-on coat of specially prepared linseed oil base lacquer. Available in sizes from ½ to 6 inches, with couplings and elbows to fit.

Triangle Electric Metallic Thin Wall Conduit is welded from high grade steel strip, insuring a perfectly true tube of uniform thickness and strength. Hot dip galvanized uniformly both inside as well as outside. Threadless. Available in ½ through 2 inch sizes.

Now your requirements for rigid steel and thin wall conduit can be met faster, more dependably, since Triangle's newly expanded plant is in production. Located in Moundsville, W. Va., hard by the steel center of Wheeling, this enlarged manufacturing establishment incorporates latest advancements in production equipment to assure greater output and the uniformly high quality for which Triangle has been famous for over 30 years.

While output of steel conduit is at present limited by circumstances beyond Triangle's control, when these conditions change you can count on Triangle for an *immediate* increase in shipments. If there's a bottleneck in steel conduit, it won't be in Triangle's new Moundsville plant!

For *Extra* quality — at NO extra cost — insist on TRIANGLE!

NOW SERVES YOU Better, Faster!

If It Bears This Trade Mark *It's Made by Triangle . . .*

If It's Made by Triangle IT MUST BE RIGHT!

For latest information on deliveries, contact your nearest Triangle distributor or representative, or write

TRIANGLE CONDUIT & CABLE CO., INC.

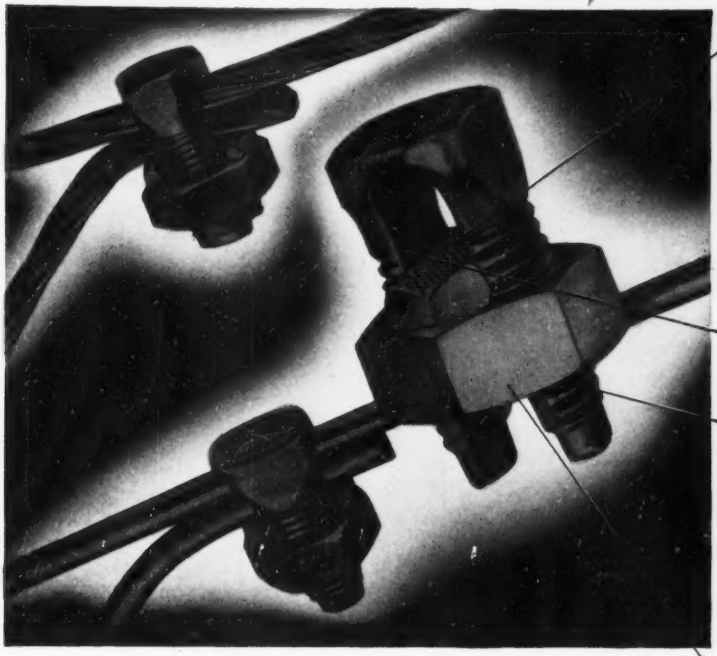
1900 Jersey Avenue, New Brunswick, N. J.

ARTERIES FOR ELECTRICAL SYSTEMS INCORPORATED

IT MUST BE RIGHT!

BUILDING WIRE • BARE WIRE • ARMORED CABLE • "GLAZON" TRIEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE, SERVICE DROP, VARNISHED CAMBRIC BRAIDED OR LEADED, TRIOPRENE TRENCH, POWER AND PARKWAY CABLES
RIGID CONDUIT • ELECTRIC METALLIC THIN WALL CONDUIT • FLEXIBLE STEEL CONDUIT

Accents on Accuracy



in the manufacture of

SOLDERLESS CONNECTORS

Strong, sound alloys, not subject to heavy atmospheric corrosion, are precision-processed to provide a high percentage of thread engagement. The tough, smooth thread surfaces will not score or drag making certain of effective tightening. Only by holding each of the four critical dimensions to less than a hair's breadth can the tightening force be applied to a sufficiently large area to assure the utmost efficiency. Reliable precision processes hold all critical points to the closest possible tolerances.

1. Contacts have only a small fraction of the amount of "draft" that is considered good production practice — the entire height of contact is accurate in maintaining position of threads.

2. Slot size is held to close limits and walls of the slot are kept accurately parallel.

3. Precise limits on bolt dimensions insure a thread that is accurate in fullness, shape and contour, to fit the co-operative nut thread efficiently.

4. Forged nut of tough grain is precision tapped to give high class thread, smooth surface and high percentage of thread engagement.

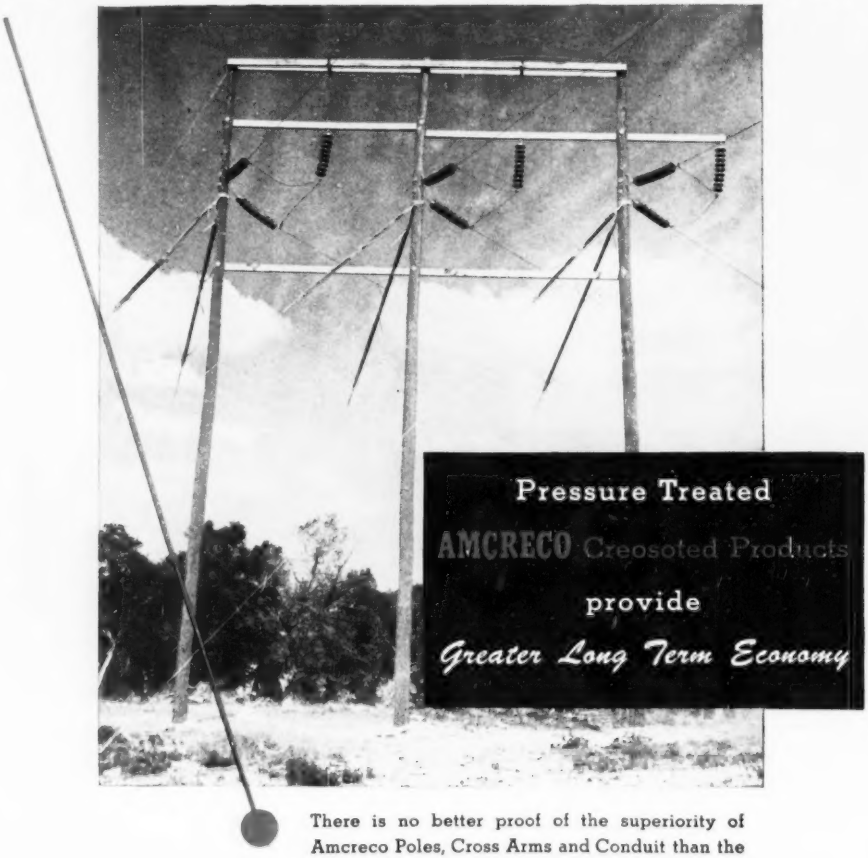
POWER-LINE CONNECTORS
AND
CONSTRUCTION SPECIALTIES

Reliable ELECTRIC COMPANY

3145 CARROLL AVENUE, CHICAGO 12, ILLINOIS

OVER 40 YEARS OF SERVICE TO THE UTILITIES

THE PROOF *is in the service records!*



There is no better proof of the superiority of Amcreco Poles, Cross Arms and Conduit than the actual service records. It is the best indication of the long pole life and freedom from maintenance troubles for users of Amcreco. We will be pleased to show you typical service records and point out how Amcreco can reduce your cost per pole per year. Write today.

Amcreco
Lowry Process
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AMERICAN CREOSOTING COMPANY
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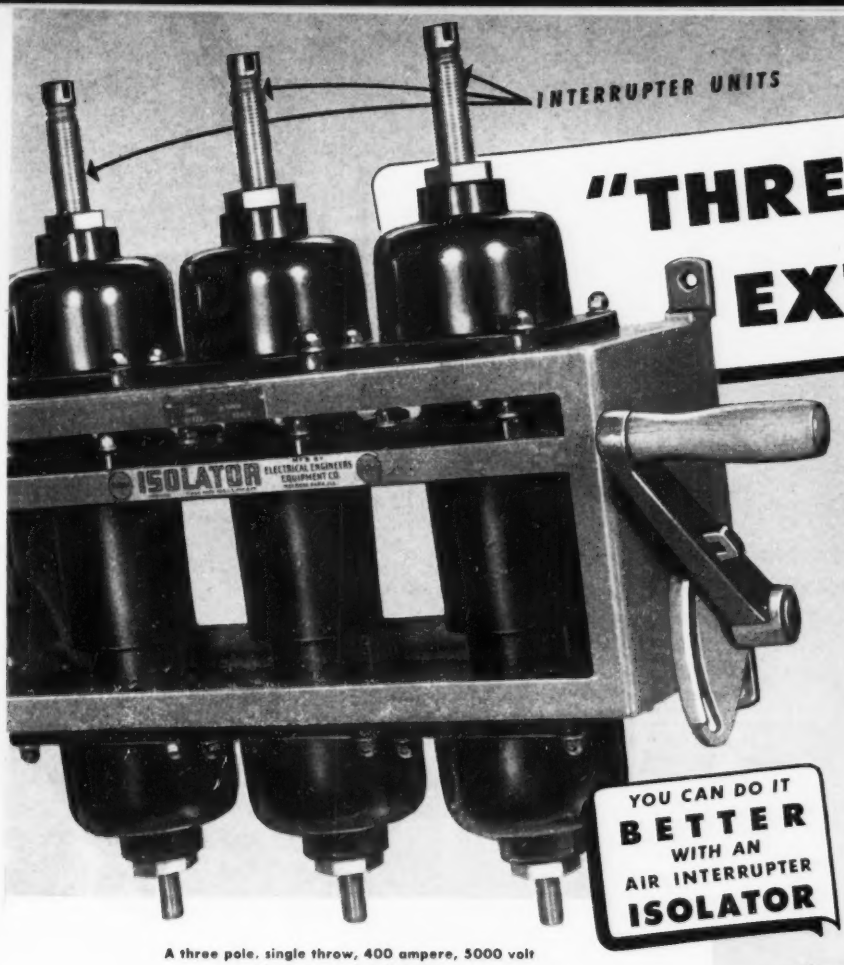
LOUISVILLE, KENTUCKY

POLES • CROSS ARMS • CONDUIT



"THREE E" EXTRAS

"THREE E'S" CONSTANT IMPROVEMENT PROGRAM MEANS GOOD PRODUCTS THAT SURPASS SPECIFICATIONS

YOU CAN DO IT BETTER WITH AN AIR INTERRUPTER ISOLATOR

A three pole, single throw, 400 ampere, 5000 volt Air Interrupter ISOLATOR.

5000 volt Air Interrupter ISOLATOR used to break charging currents in large three-phase air-cooled transformer.

As a device for disconnecting of high voltage circuits the Three E ISOLATOR stands in a class by itself. The Air Interrupter ISOLATOR, the latest member of the Three E ISOLATOR family, incorporates all the exclusive features of the disconnect ISOLATOR that has made the same so popular. In addition, it is so constructed with removable interrupter units in upper studs so that it can successfully interrupt moderate load currents, and charging currents of transformers, regulators, cables and other equipment.

The Air Interrupter type of ISOLATOR can be combined with a pothead body to form an Air Interrupter CABLE ISOLATOR which makes an excellent device for interrupting charging currents of lead covered power cables.

Send for Bulletin 138 which gives detailed information and a complete listing of Air Interrupter ISOLATORS up to and including 15000 volt ratings.

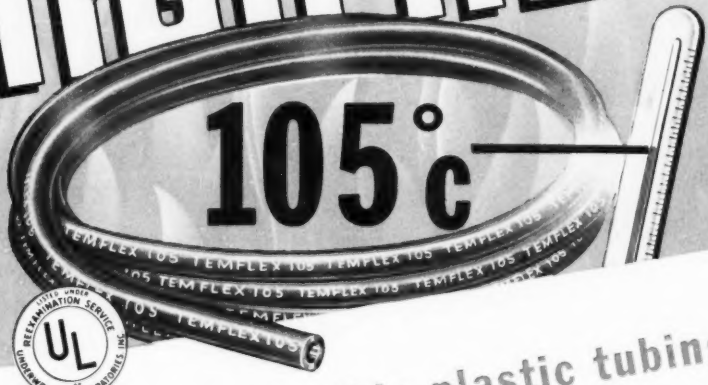
THREE E — ELECTRICAL ENGINEERS EQUIPMENT CO. — MELROSE PARK ILL. U.S.A. — THE MARK OF QUALITY

ELECTRICAL ENGINEERS EQUIPMENT CO.

MELROSE PARK, ILLINOIS

DEFIES HIGH HEAT

105° c


TEMFLEX 105 TEMFLEX 105 TEMFLEX 105 TEMFLEX 105 TEMFLEX 105
TEMFLEX 105 TEMFLEX 105 TEMFLEX 105 TEMFLEX 105 TEMFLEX 105

UL

Temflex 105 flexible plastic tubing

Send for the U. L. report on TEMFLEX 105 and make your own comparisons for ALL characteristics

TEMFLEX 105 flexible plastic tubing gives high heat protection with a "premium." It meets all UL requirements for continuous service at 105° C. . . . *and more.* Further tests in our laboratories prove that **TEMFLEX** 105 provides complete security for important wiring at temperatures *greater* than UL specifications. It bends double without cracking after unusual heat conditioning . . . resists oil, varnish, baking, and chemicals. Distinguish **TEMFLEX** 105 by the name imprinted the length of the tubing. Use it wherever equipment wiring must defy heat and oil.

Test Data

Tensile Strength, lbs/in²	3,000
After 60 days at 113° C.	3,200
Dielectric Strength — V.P.M.	1,200
Minimum Elongation at break	300%
After 60 days at 113° C.	315%

IRVINGTON's own oil resistance tests of TEMFLEX 105 after 1,000 hrs. at 105° C. show . . .

	Tensile*	Elongation*	Dielectric Strength Short Time*
In Wemco Oil	99	105	75
In G.E. 10-C Oil	102	115	87

*Expressed as percentages of original values.

IRVINGTON INSULATION

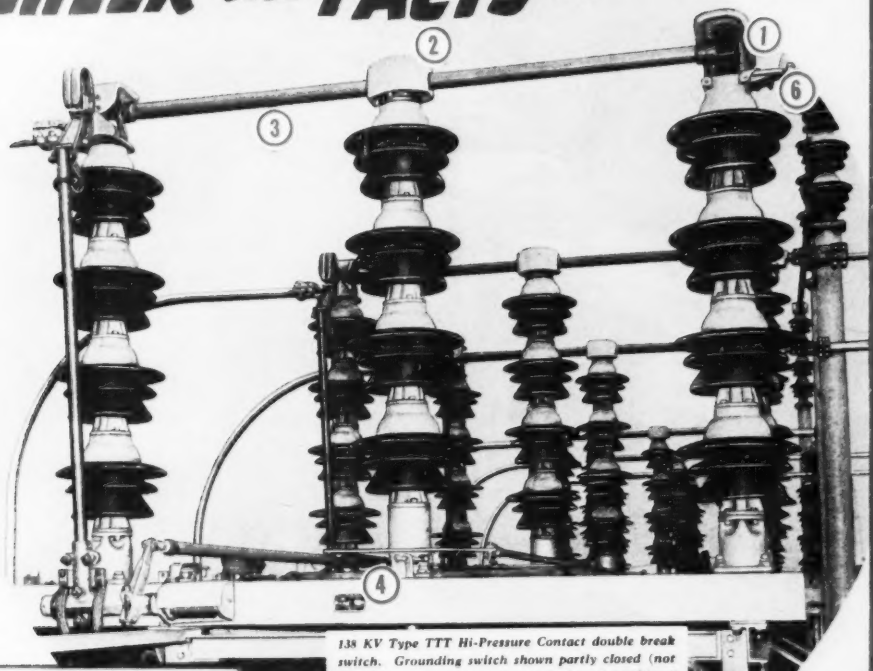
Samples of Temflex 105 tubing and full technical data will be sent on request.

IRVINGTON *Varnish & Insulator Company*

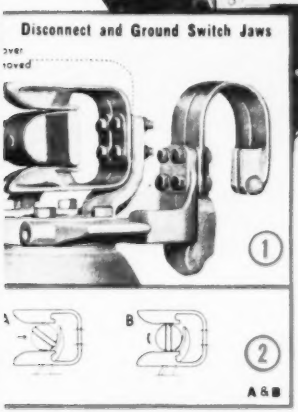
Irvington 11, New Jersey

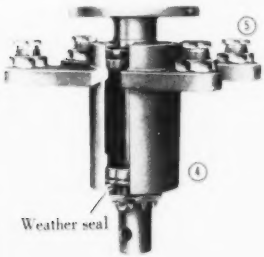
Authorized distributors in Atlanta; Baltimore; Berkeley; Bluefield, W. Va.; Boston; Charlotte; Chicago; Cleveland; Dallas; Denver; Los Angeles; Milwaukee; Minneapolis; New Hartford, N. Y.; New Orleans; New York; Philadelphia; Pittsburgh; Portland, Ore.; St. Louis; Seattle; Hamilton, Ontario, Canada.

CHECK the FACTS . .



138 KV Type TTT Hi-Pressure Contact double break switch. Grounding switch shown partly closed (not energized). Jamaica, L. I., Substation, Consolidated Edison Co.





Because you demand your switches **RUGGED**

1. CONTACTS—Hi-Pressure, self cleaning, beryllium jaws. Proper pressure, plus a clean contact makes a dependable electrical and mechanical contact.
2. BLADE MECHANISM—rotates one-piece tubular blade, AFTER blade enters jaw free of pressure—all with continuous motion.
   - A—Blade in closed position by insulator rotation.
   - B—Contact closed by blade rotation.
3. ONE-PIECE BLADE—High strength, high conductivity I. P. S. tubing.
4. BEARING—weather sealed, greaseless for smooth easy operation.
5. LEVELING SCREWS for alignment - also featured on all insulator stacks.
6. TERMINAL—four half-inch bolt, clamp type.

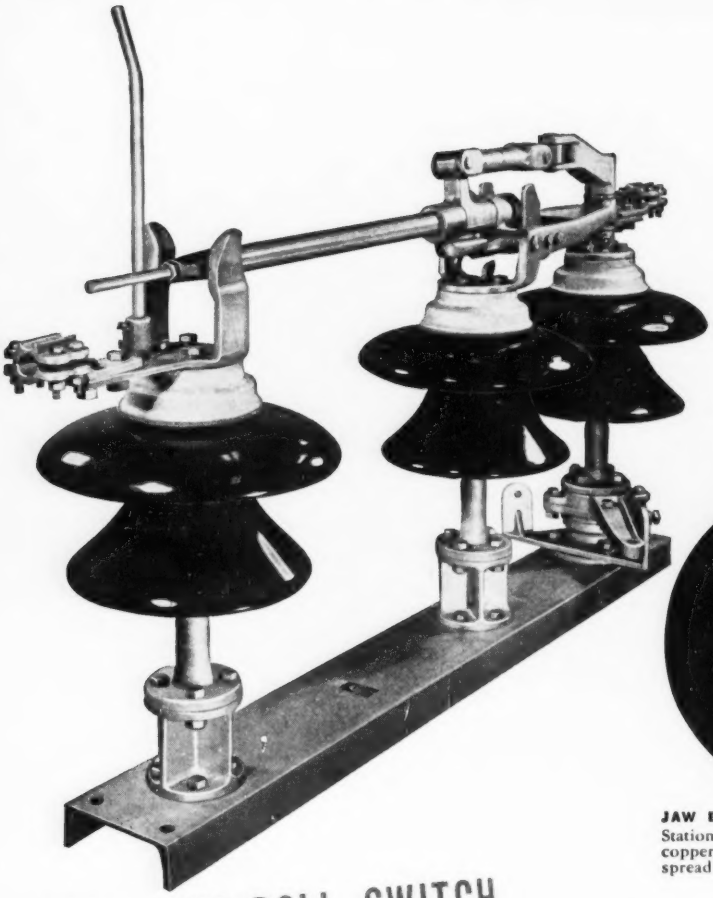
R&IE

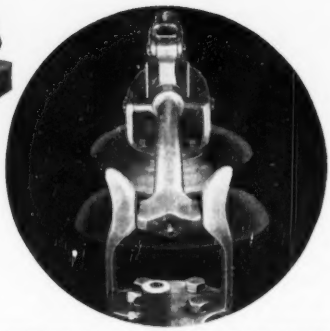
RAILWAY and INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

AFFILIATED WITH THE I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.
IN CANADA—EASTERN POWER DEVICES LIMITED, TORONTO

The Check List

- CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- DISTRIBUTION EQUIPMENT
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SWITCHING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES





JAW END HIGH-PRESSURE CONTACT
Stationary contact of a one-piece beryllium copper casting exerts high pressure when spread by rolling action of moving contact.

ELPECO DUO-ROLL SWITCH

with two simple high-pressure contacts

● You get high-pressure contact at both hinge and jaw end of the new Elpeco DUO-ROLL switch.

The non-aging properties of the beryllium copper contacts assure unchanging contact pressure during service. The simple rotary principle of operation makes the contacts self cleaning on opening or closing. Under icing or adverse weather conditions, the simple rotary motion releases the contact pressure and breaks the ice with a minimum of effort. No adjustments are needed or can be made during installation to affect the high-pressure contact.

Available in horn gap or disconnecting types from 7.5 Kv. to 69 Kv. For detailed information request descriptive catalog.

HINGE END HIGH-PRESSURE CONTACT
The wide angle of high-pressure contact makes contact positive and not at all critical —even with undertravel or overtravel in group operation.

ELECTRIC POWER EQUIPMENT CORP.
412 North 18th Street Philadelphia 30, Pa.

YOU'RE right, Mr. Motorist! You can easily read the fine print with the new Joslyn Permalux Suburban Luminaire. Because this reflector directs a brilliant light right where it is wanted—along the street and sidewalks.

The Permalux Reflector is made of stainless steel with hard highly polished specular surface for high, permanent reflectivity . . . there is no thin film to erode or wear away!

The attractive appearance and modern design of the Joslyn Permalux Reflector combines high efficiency with low cost. The variable cutoff angle from 45 degrees on the house side to 83 degrees up and down the street assures maximum utilization with minimum glare.

Joslyn reflector attachments are available to fit most porcelain and metal heads.

It says here, but NOT in fine print, you'll be wise to modernize your old fashioned inefficient luminaires with the Joslyn Permalux reflectors.

- Controlled reflection puts light where it is needed
- High reflector efficiency provides more useful light per watt
- Irritating glare is eliminated
- Rugged durable construction
- Economical initial cost plus long life

Branch offices in principal cities

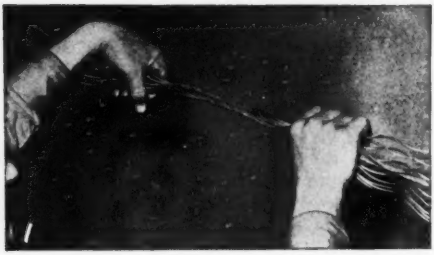
•

THE JOSLYN CO.
THE SOUTH EAST JOSLYN CO.
SOUTHERN JOSLYN CO.
JOSLYN SOUTHWEST CO.
JOSLYN PACIFIC CO.

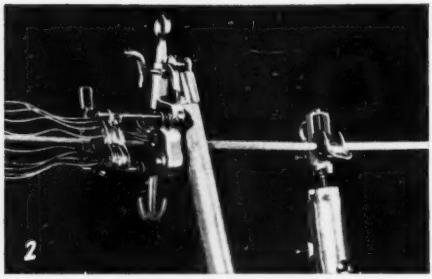
JOSLYN MFG. AND SUPPLY CO.

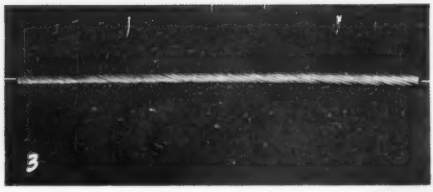
Complete Pole Line Equipment

2300 NORTH WACKER DRIVE, CHICAGO 6, ILL.



PLP hot-line TAP ARMOR . . . easy to apply-



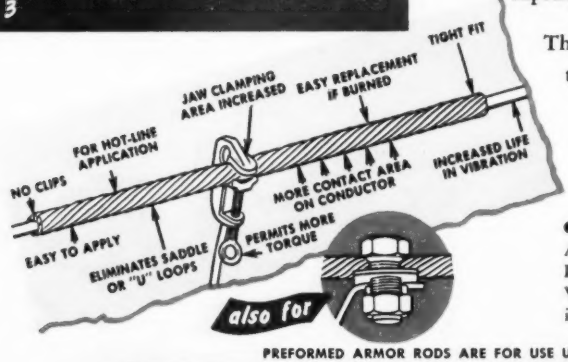


● Tap-Armor Rods are simply short lengths of PLP Armor Rods. They assure the same simplicity and ease of application. For hot-line taps, they eliminate troublesome concentrations of stresses; prevent arcing and resultant burning of the conductor caused by loosened clamps; and give a positive damping of vibration...one of the main causes of loosened clamps.

FOR COLD-LINE application, simply twist and wipe into place on the conductor as shown by Figure 1. No special tools are needed. PLP Tap Armor grips so snugly that clips or clamps are eliminated.

FOR HOT-LINE application, the set of tools shown in Figure 2 makes the job easy. Safely and rapidly, PLP Tap Armor is put in place.

The result for either hot or cold lines is the same . . . Figure 3. Conductor life is increased, electrical and mechanical characteristics are improved. A COOL clamp is the result.



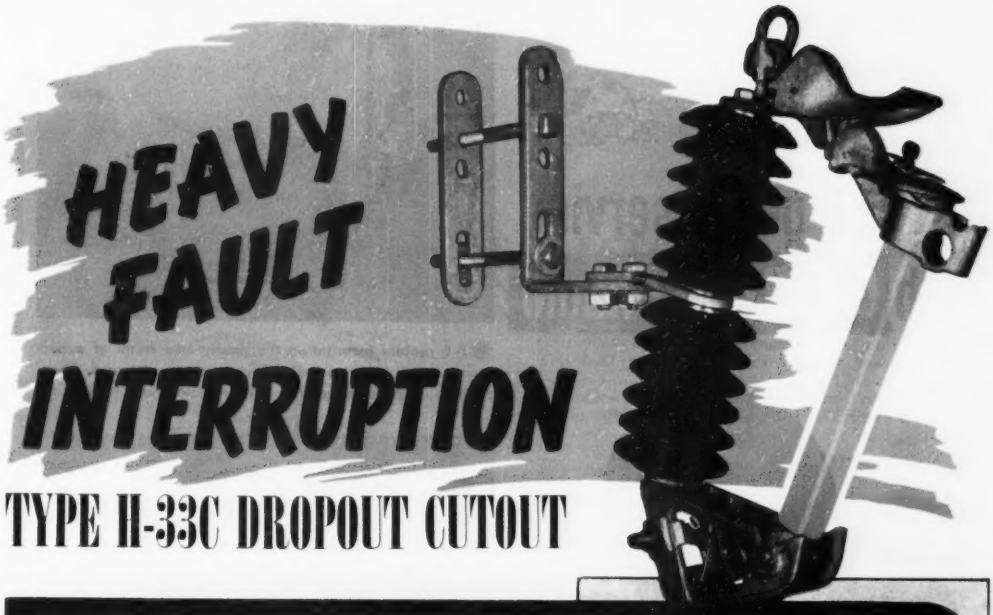
● Like to know more about PLP Armor Rods? Any Salesman of Line Material Company, Locke Incorporated or American Steel & Wire Company will gladly give you complete information and prices. Or write directly to us.

PREFORMED ARMOR RODS ARE FOR USE UNDER PATENT NO. 2,275,019—OTHER PATENTS PENDING

PLP COMPANY

PREFORMED LINE PRODUCTS COMPANY

1051 POWER AVENUE • CLEVELAND 14, OHIO



HEAVY FAULT INTERRUPTION

TYPE H-33C DROPOUT CUTOUT

ANOTHER IN A LINE OF DEPENDABLE PRODUCTS

FUSING PROBLEMS presented by increasing short-circuit capacities of distribution systems have increased a demand for a dependable and economical device for interrupting heavy fault currents.

Southern States early recognized this problem, and developed the type **H-33C Dropout Cutout** to meet the growing need. This pioneer development has demonstrated the dependability and effectiveness of the **Expulsion Fuse** for this class of service under all-weather conditions.

TYPE "H33-C" RATINGS

Catalog Numbers	Voltage (Kv)	Current (Amp)	Interrupting Capacity (R.M.S. Amp)
H-73621-C	5	50	9,000
H-73611-C	5	100	13,000
H-73601-C	5	200	17,000
H-73622-C	7.5	50	7,000
H-73612-C	7.5	100	10,000
H-73602-C	7.5	200	14,000
H-73623-C	15	50	6,000
H-73613-C	15	100	9,000
H-73603-C	15	200	11,000

Southern States SS **Equipment Corp.**
HAMPTON GEORGIA

REPRESENTATIVES IN FOLLOWING CITIES:

BIRMINGHAM, ALABAMA
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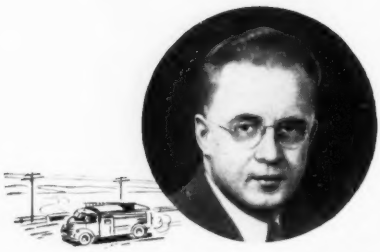
MEMPHIS, TENNESSEE
DALLAS, TEXAS
HOUSTON, TEXAS
LUBBOCK, TEXAS
SALT LAKE CITY, UTAH
SEATTLE, WASHINGTON
MILWAUKEE, WISCONSIN

BIGGER rural loads BETTER urban service with G-E 2-Way Radio

G-E mobile installation fits neatly into trunk of supervisor's cars. Note control panel below dashboard. Neat, rubber-covered handset wire coils compactly when not in use.



W. S. WILDER—Technical Assistant to Chief Electrical Engineer, Wisconsin Electric Power Company

"G-E radio gives us fast, dependable communication for critical maintenance work. This means better service for our customers at all times."

At G-E remote control console in headquarters, A. P. Schupmehl, Supervisor, sends out a call to cars.

Transmitter house and 260-foot FM antenna tower on hill near Milwaukee. High ground and lofty reach of this antenna gives station maximum range for the area. Transmitter is G-E FM 250-watt.

●The Wisconsin Electric Power Company serves Milwaukee and nearby cities. The company also distributes power through its feeder lines to hundreds of farms in the Dairy State. Today Wisconsin farmers are using more and more electricity for milking, separating and processing of dairy products.

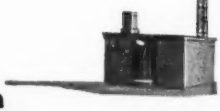
To keep rural lines open, utility service trucks are on the alert at all hours. General Electric 2-way radio in these vehicles saves valuable time, permits dispatching to critical points instantly, easily, in any weather.

More and more electric utility companies in the U.S. and Canada are putting their confidence in G-E communication equipment.

General Electric will provide a complete radio system to fit your requirements—to help you give best service to your utility customers.

FREE BULLETIN

Colorful booklet about G-E 2-way radio will be sent to you on request. Ask us for it. *General Electric Company, Room 102, Bldg. 3, Electronics Park, Syracuse, N. Y.*



You, too, can put your confidence in—

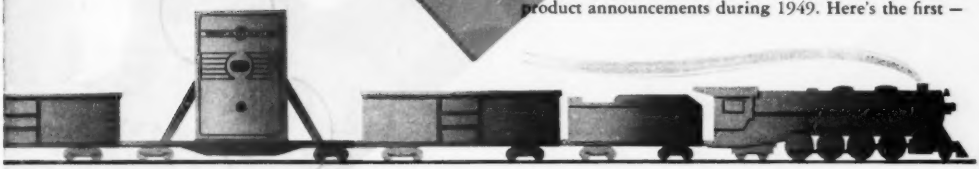
GENERAL ELECTRIC

HERE COMES THE

Trumbull Train

OF ELECTRICAL PROGRESS

A whole parade of new Trumbull products is headed your way! A new advancement in the entire line of Trumbull products — Flex-A-Power systems, Panel Boards, Control Centers, Switches and Motor Starters — all radically different. So watch for Trumbull's new product announcements during 1949. Here's the first —



A NEW

Magnetic Motor Starter and Magnetic Contactor

New, from top to bottom, Trumbull Starters and Contactors in sizes 0, 1, 2, 3 give maximum protection to motors up to 50 hp, 440 v. Look at all their important new advantages:

LONGER CONTACT LIFE —
Actual factory tests show the silver contacts on the Trumbull starter "make and break" for millions of operations — many times more than any starter on the market.

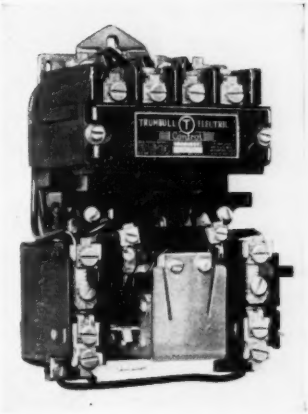
EASY TO MAINTAIN —
Silver contacts have permanently attached springs that are easy to remove. Terminals are located on the front and are easy to wire — a screw driver is all you need to disassemble starter — can be accomplished in less than a minute.

EASY TO INSTALL AND SERVICE —
Note convenient knockouts, large terminals, front connections, and ample wiring space.

GREATER PROTECTION —
Bi-metallic relay heaters follow motor's heating curve. Easily adjusted for automatic or manual reset.

BUILT TO LAST —
All parts resist corrosion and moisture. Examine plastic coil enclosure to see how the tough varnish impregnation protects windings. Contact points and cold-molded asbestos arc hood eliminate arcing . . . give clean "make and break" contact.

QUIET OPERATION —
Permanent lubricant impregnated in the plastic coil enclosure keeps magnet guides sliding smoothly . . . eliminates low voltage "chatter."



FOR MORE INFORMATION about this latest Trumbull development, write for Circular TEC 11. THE TRUMBULL ELECTRIC MANUFACTURING CO., Plainville, Conn. Other factories and offices throughout the United States. Foreign representation.

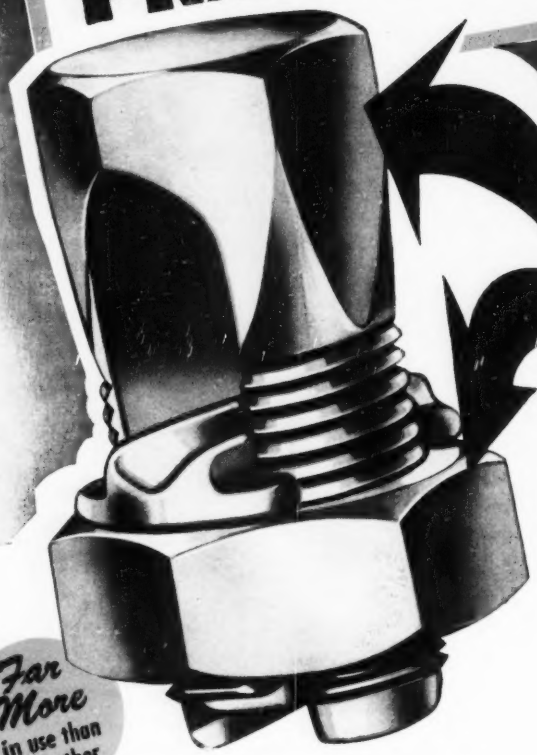
Men Who Observe the Best Electrical Practice Make It a Practice to Use

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS

Approved by UNDERWRITERS LABORATORIES

Here's the MOST PRACTICAL design



LARGER SURFACES

to grip with wrenches from ANY ANGLE, using ANY kind of wrench—Box, Socket or Open End.

MAXIMUM CONTACT provided by V-groove; conductors protected by bevelled slot.

PRECISION MADE, with rigid inspection. Smooth accurate threads assure maximum pressure —permanently maintained.

Far More in use than any other

For taps, dead-ends, parallel connections, etc., in any location. Can be furnished in bronze or aluminum. Re-usable over and over.

With or without retainer

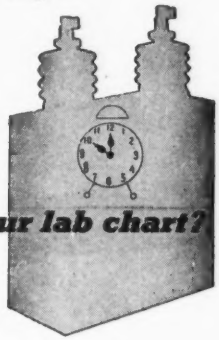
PENN-UNION ELECTRIC CORPORATION, Erie, Pa.

Canada: Dominion Cutout Company, Ltd., 250 Richmond St. West, Toronto

The COMPLETE Line of Conductor Fittings

PENN-UNION

how do you
select a capacitor for
dependability...



by a 10 hour lab chart?

or

a 10 year service report?

it's a fact
proved by actual use
for over 10 years!

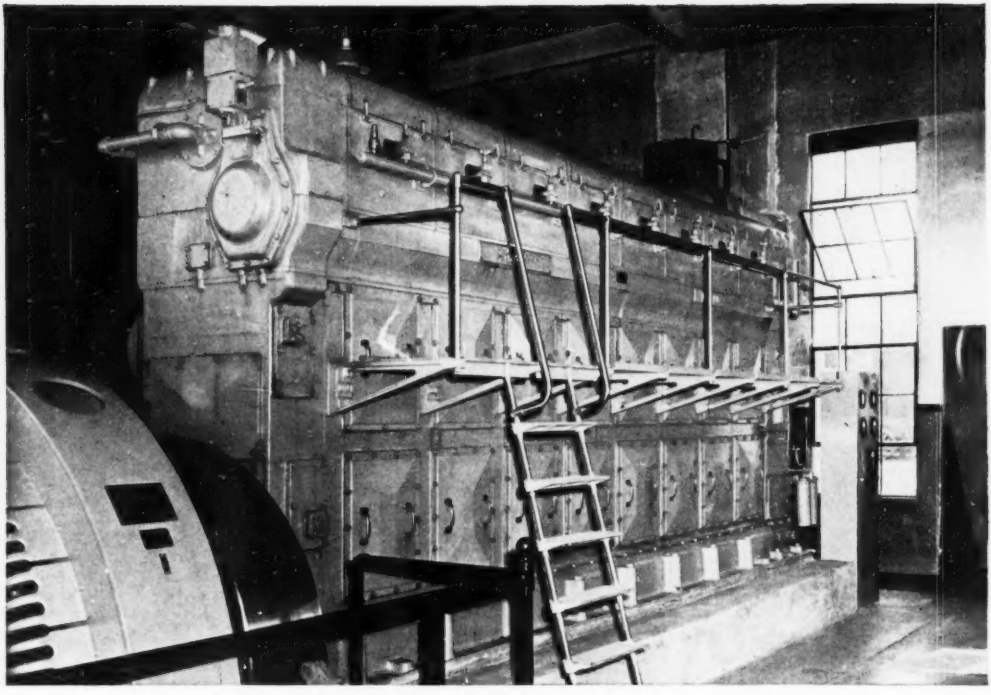
cornell-dubilier capacitors for power-factor improvement

Standard 540 kva., 4,800 Volt, Delta Connected Substation Capacitor, With Breaker Compartment

Time is the surest of all capacitor test yardsticks. Not by hours — but by 10 years of field service as achieved by Cornell-Dubilier Capacitors wherever installed for power-factor improvement. Field service records of more than 3,500 major installations — over 800,000 kva. — offer you proof too that C-D is preferred for its long life and dependability in actual use. Call in a seasoned C-D engineer to analyze your power-factor requirements. Cornell-Dubilier Electric Corporation, Dept. D-29 South Plainfield, New Jersey. Other plants in New Bedford, Worcester, Brookline, Massachusetts; and Providence, Rhode Island.

CORNELL-DUBILIER • WORLD'S LARGEST MANUFACTURER OF CAPACITORS

Follow the leaders.
Demand dependable C-D Capacitors
for your system.



THERE'LL BE SOME CHANGES MADE

Many communities and industries, located near a source of natural gas, are getting lower cost electric power with dual fuel Superior Diesel Engines. The dual fuel feature offered by Superior enables them to burn low cost gas in the summer and switch to oil in winter when gas is in short supply. Superior . . . the first Diesel with push-button control of fuel selection permits you to change from oil to gas, or gas to oil instantly . . . with just a flick of a finger.

There are many other Superior operating economies that are due to the following features: Conservative Ratings • Fuel Economy • Precision Bearings • Heavy Rigid Crankshafts • Strong Bases and Cylinder Blocks • Proved Roller Chain Camshaft Drive • Oil Cooled Pistons. One of our field engineers will be glad to show you the advantages of these features, or we will be glad to send you a fully illustrated booklet.

THE NATIONAL SUPPLY COMPANY
SUPERIOR ENGINE DIVISION
Plant and General Sales Office: Springfield, Ohio

THE NATIONAL SUPPLY COMPANY NSCO

Superior DIESEL

Since you're the man most concerned by that steadily rising curve labeled "operating costs," you're constantly searching for machines and methods that will help reduce expenses.

That's why Remington Rand now invites you to see the new "Foremost" bookkeeping machine in action.

New from core to keyboard, this completely electrified machine produces *all* your accounting records with new efficiency. New mechanical features speed every machine operation . . . new functional design simplifies each operator motion. RESULT: your accounts receivable, payrolls and accounts payable are turned out faster – with less effort – at lower cost.

But see for yourself how the "Foremost" bookkeeping machine will force down *your* "operating costs" curve. Call your local Remington Rand representative today.

"Fashioned for Business Administration" tells the complete story. Write for your free copy to Remington Rand Inc., Dept. EL2, 315 Fourth Ave., New York 10.

here's why . . .

the new "Foremost" is your best bookkeeping machine value . . .

FASTER RESULTS – completely electrified . . . balances computed and printed automatically . . . improved automatic tabulation and column selection . . . new high speed spacing, timing and carriage return.

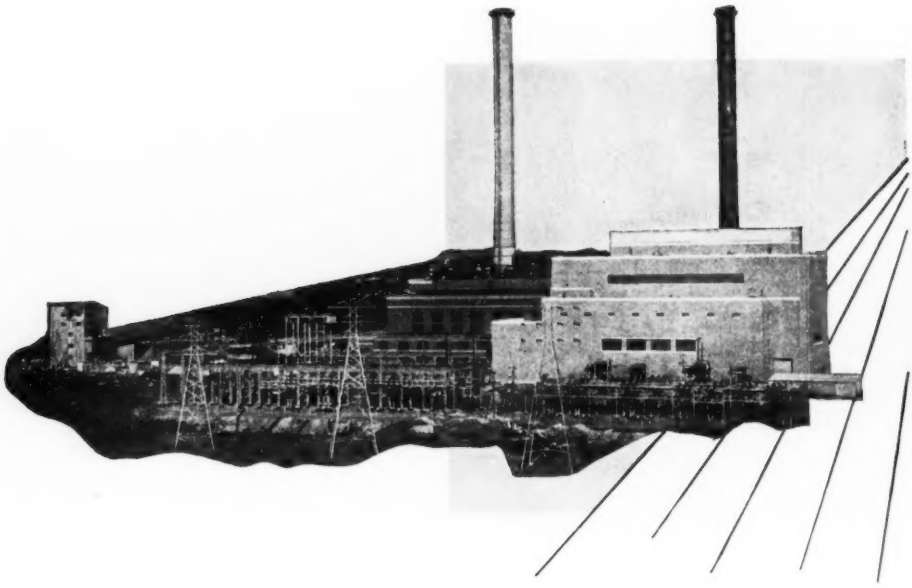
SIMPLER OPERATION – "one-operation" insertion, collation and alignment of forms . . . standard keyboard with only one set of numerals . . . new organ type, finger-grooved keys respond with uniform impressions . . . completely visible writing line . . . new magnified register totals assuring easier reading and transcribing.

PRODUCES ALL RECORDS – designed for accounts receivable, payrolls, accounts payable or any other record . . . "snap-on" type registers easily repositioned for new applications . . . quickly adaptable to column arrangement on any accounting form.

FUNCTIONAL DESIGN – fashioned for maximum utility plus streamlined beauty of lines . . . all moving parts and mechanisms enclosed . . . minimum of feature keys and levers . . . durable unit construction.

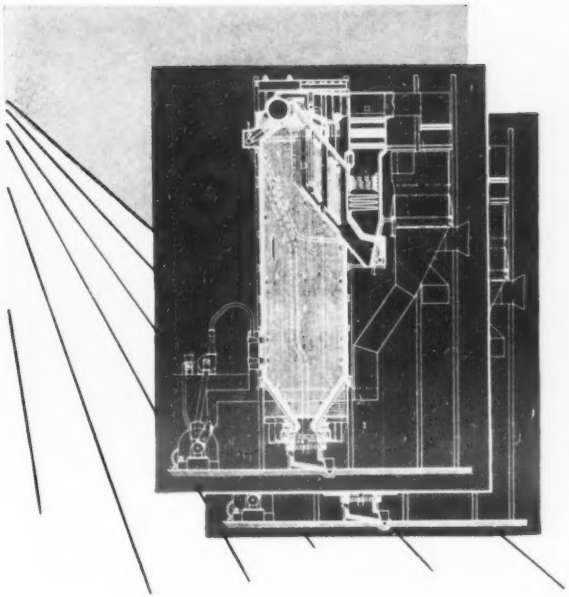
THE NEW *Remington Rand* BOOKKEEPING MACHINE

Looking ahead



The new extension of the Barbadoes Station of the Philadelphia Electric Company houses two large Foster Wheeler steam generators which are capable of producing a total of 1,200,000 lb of steam per hr. The units will serve two turbine generators with an aggregate capacity of 132,000 kw.

These single-pass, baffleless steam generators having liberal furnace dimensions, are based on what is now known as the "Preferred Standard" design which promises both first cost savings and long range economy. The design also embodies Foster Wheeler features of slag-free fur-



TWO FOSTER WHEELER STEAM GENERATING UNITS for BARBADOES STATION PHILADELPHIA ELECTRIC CO.

Steam Capacity per Unit
600,000 lb per hr

Superheat Control Range
330,000 to 600,000 lb per hr

Pressure Superheater Outlet
825 psi

Final Steam Temperature
900 F

Bituminous Coal Pulverized in FW Ball Mills (two per unit)

nace arrangement, Foster Wheeler condenser-type steam temperature control, low draft loss, and efficient heat recovery arrangement. Each steam generator is equipped with two Foster Wheeler ball mill pulverizers.

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, NEW YORK.

FOSTER FW WHEELER

92% LESS TIME "GETTING AT THE WORKS"

with the NEW CM-22 subway network protector door

Minimize your maintenance costs with this new quick-opening CM-22 network protector door (on units up to 1,600 amperes, incl.). A maintenance man-hour saver, this door can be opened by loosening only 2 bolts instead of a minimum of 28 bolts as in the past . . . a 92% saving in time. A few quick twists and the door is open.

Making this new improvement possible is a new tubular neoprene gasket with extremely high compressibility. It provides an effective, efficient seal with no possibility of leakage.

This is another Westinghouse addition to a long line of STANDARD features that save maintenance dollars:

1. **Reduced duty on main contacts**
2. **Fewer adjustments**
3. **Easy dismantling**
4. **Captive hardware**
5. **Accessible relays**
6. **Increased interrupting ratings**

For network protectors for *any* system, consult Westinghouse. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

. . . and for growing loads

The new CM-22 network protector now provides increased interrupting ratings—16⅔ to 50%—to protect present and future loads.

I-60687

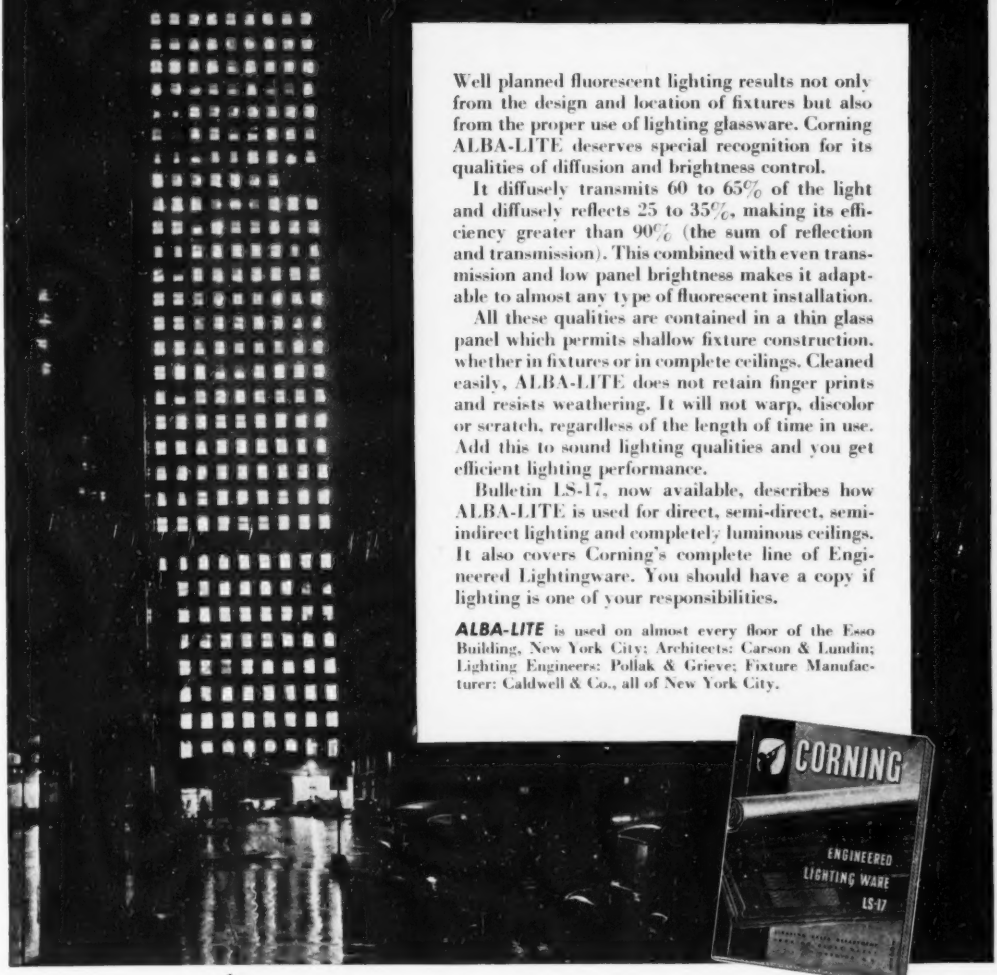
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

PIONEER IN NETWORK PROTECTORS

FOR 26 YEARS

WHY A WELL PLANNED LIGHTING INSTALLATION NEEDS CORNING ALBA-LITE



Well planned fluorescent lighting results not only from the design and location of fixtures but also from the proper use of lighting glassware. Corning ALBA-LITE deserves special recognition for its qualities of diffusion and brightness control.

It diffusely transmits 60 to 65% of the light and diffusely reflects 25 to 35%, making its efficiency greater than 90% (the sum of reflection and transmission). This combined with even transmission and low panel brightness makes it adaptable to almost any type of fluorescent installation.

All these qualities are contained in a thin glass panel which permits shallow fixture construction, whether in fixtures or in complete ceilings. Cleaned easily, ALBA-LITE does not retain finger prints and resists weathering. It will not warp, discolor or scratch, regardless of the length of time in use. Add this to sound lighting qualities and you get efficient lighting performance.

Bulletin LS-17, now available, describes how ALBA-LITE is used for direct, semi-direct, semi-indirect lighting and completely luminous ceilings. It also covers Corning's complete line of Engineered Lightingware. You should have a copy if lighting is one of your responsibilities.

ALBA-LITE is used on almost every floor of the Esso Building, New York City; Architects: Carson & Lundin; Lighting Engineers: Pollak & Grieve; Fixture Manufacturer: Caldwell & Co., all of New York City.

CORNING GLASS WORKS, DEPT. EW-2, CORNING, N. Y.

Please send me your Data Book LS-17, "Corning Engineered Lightingware," describing MONA-LITE, ALBA-LITE and other Corning products.

NAME_____ TITLE_____

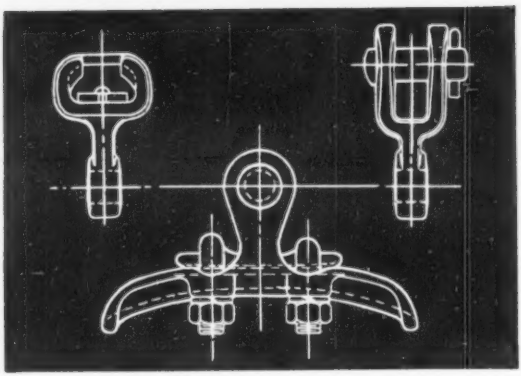
COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

New BTC Forged Steel Suspension Clamps with Design Improvements

6200A-U
for Conductor



New Series 6200A Forged Steel Suspension Clamps for all Conductors and Ground Wires, except the Hollow Copper Types.

In the interest of improved field performance, the popular Series 6200 clamps has been redesigned. Lighter weight, shorter Clamp Body, improved Clamp-Body-Seat and Keeper contours, and maximum clamping pressure at Keeper center are factors in preventing possible cable-vibration damage. Greater Vertical-Line-Angle accommodation. Socket and new clevis connectors are forged steel. Absence of corona-inducing sharp edges.

Cable Sizes	Catalog Numbers — Type of Connector			Body Length	Ultimate Strength Pounds
	Socket	Clevis	None		
.125″ to .46″	6200A	6230A	6240A	6½″	15,000
.312″ to .60″	6201A	6231A	6241A	6½″	17,000
.187″ to .60″	*6251A	*6261A	*6271A	6½″	17,000
.50″ to .70″	6202A	6232A	6242A	7¼″	18,000
.50″ to .82″	6203A	6233A	6243A	7¼″	18,000
.625″ to 1.00″	6204A	6234A	6244A	8″	25,000
.625″ to 1.15″	6205A	6235A	6245A	8″	25,000
.85″ to 1.27″	6255A	6265A	6275A	9½″	25,000
1.125″ to 1.375″	6206A	6236A	6246A	9½″	25,000
1.125″ to 1.45″	6257A	6267A	6277A	9½″	25,000
1.125″ to 1.60″	6207A	6237A	6247A	9½″	25,000
1.375″ to 1.80″	6208A	6238A	6248A	10½″	25,000
1.375″ to 2.00″	6209A	6239A	6249A	10½″	25,000
1.625″ to 2.25″	6210A	6280A	6290A	11¼″	25,000

*Reversible Two-Groove Keeper for greater Cable Size Range

Specify J or U Bolts by suffix "J" or "U" to catalog number. Specify Copper or Aluminum liners when required.

A postcard puts your name on our mailing list for data sheets.

Sold only through your insulator manufacturer

THE BREWER-TITCHENER CORPORATION, CORTLAND, N. Y.

FOR A COMPLETE AND PROVED LINE OF SQUARE TUBE CONNECTORS SPECIFY DELTA-STAR

BECAUSE . . . Delta-Star can supply you with a complete line of square tube connectors that has been thoroughly proved by laboratory tests and long successful service.

These connectors are actually cast-to-size in our own foundry of an alloy stronger than copper. The surface strength is left intact by the elimination of machining. Heavy reinforcing ribs insure maximum mechanical strength and increase the radiating surface. The hard, tough surfaces actually dig into the bus copper forming a great number of contact points. Each point carries a relatively small current compared to what a point pressure contact could carry. These points also provide a positive gripping action.

Heavy Duronze bolts are used thruout insuring a joint which will carry the full rating of the conductor continuously without undue heating.

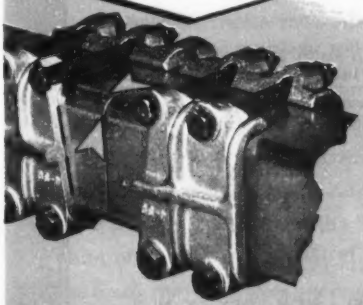
Whenever possible the design embodies two halves of like dimensions, eliminating the need to keep them in pairs. This two-half construction also permits easy intallation.

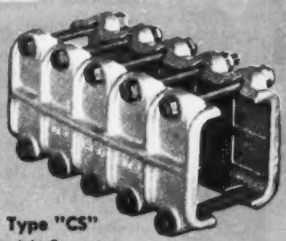
Type "CFT"
Tee Connector
Tubing to Pipe

Type "CT"
Tee Connector
Tubing to Tubing

Publication 4107
lists a typical group of fittings for a wide range of square tubing sizes.

Cut-away view showing two point-by-point contact lines at each corner of square tubing





Type "CS"
Straight Connector
Tubing to Tubing

Type "CTB"
Tee Connector
Tubing to Bar

DELTA-STAR ELECTRIC COMPANY

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NEW YORK OFFICE — 140 Cedar St., New York 6, N. Y.

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Jacksonville, Fla.
Kansas City, Mo.
Knoxville, Tenn.
Los Angeles, Cal.
Minneapolis, Minn.
Norfolk, Neb.
Norfolk, Va.
Philadelphia, Pa.
Pittsburgh, Pa.
Richmond, Va.
Roanoke, Va.
St. Louis, Mo.
San Francisco, Cal.
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Tampa, Fla.
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Honolulu, Hawaii

CANADIAN ASSOCIATE
Canadian Line Materials Limited — Toronto 14, Canada

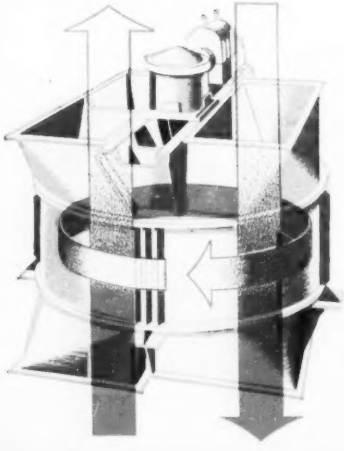
Fact File on Preheat

IN THE LJUNGSTROM, heat is not required to pass *through* the metal and its surface accumulations.

This type of air preheater maintains heat recovery at a *constant level* despite the inevitable surface accumulation of soot and fly ash.

Between cleanings, the surface "as is," acts as an efficient heat storage and transfer medium.

LJUNGSTROM



The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of power plants and other special applications confirm its high level of heat recovery and long-term service at low maintenance expense. Write for engineering details to:

THE
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CORPORATION

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Plant: Wellsville, N. Y.

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Choose the Leader . . . *For VALUE!*

CHEVROLET ADVANCE-DESIGN TRUCKS

CHEVROLET From one end of the nation to the other, more truck users buy Chevrolet trucks than any other make. Chevrolet trucks offer more of what truck users want—more power combined with economy . . . more comfort and convenience . . . greater ease of handling . . . more value from start to finish! And to all these advantages you can add the biggest premium of all—3-WAY THRIFT! Here's the one truck that combines low cost operation, low cost upkeep and the *lowest list prices in the entire truck field!*

CHEVROLET MOTOR DIVISION, *General Motors Corporation*, DETROIT 2, MICHIGAN

Chevrolet Trucks alone have all these features

Chevrolet's 4-SPEED SYNCHRO-MESH TRANSMISSION offers quicker, quieter and easier operation in Series 3800 and heavier duty trucks. Faster shifting maintains speed and momentum on grades.

Chevrolet trucks have the famous CAB THAT "BREATHES"*! Outside air is drawn in and used air forced out! Heated in cold weather.

Chevrolet's power-packed LOAD-MASTER ENGINE provides improved durability and efficiency in Series 5000 and 6000 models as well as the world's greatest economy for its size!

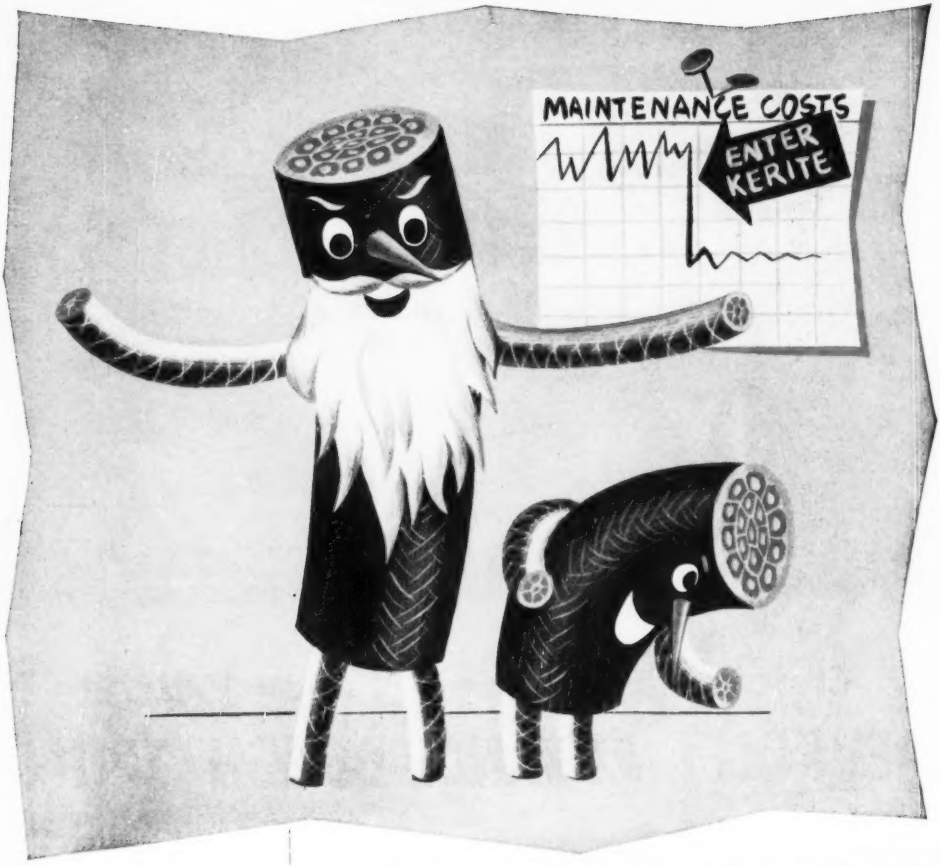
Chevrolet Advance-Design brings you the FLEXI-MOUNTED CAB, cushioned on rubber against road shocks, torsion and vibration.

Chevrolet's exclusive SPLINED REAR AXLE HUB CONNECTION adds greater strength and durability to heavy-duty models.

Uniweld, All-Steel Cab Construction • Large, Durable, Fully-Adjustable Seat • All-Round Visibility with Rear-Corner Windows* • Heavier Springs • Super-Strength Frames • Full-Floating Hypoid Rear Axles in the 3600 Series and Heavier Duty Models • Specially Designed Brakes • Hydrovac Power Brakes in Series 5000 and 6000 Models • Standard Cab-To-Axle Length Dimensions • Multiple Color Options.

**Heating and ventilating system and rear-corner windows with de luxe equipment optional at extra cost.*

CHOOSE CHEVROLET TRUCKS FOR TRANSPORTATION UNLIMITED!



Long life... Low cost per year

THE Kerite story—boiled down is just that: "Long life . . . low cost per year." Cost-conscious cable buyers love it. Kerite has been proving it, too, for more than 90 years.

Kerite makes insulated wire and cable for all types of service—from low-voltage signal circuits to power circuits and high-voltage x-ray and other electronic applications . . . and for underground, overhead, and submarine installations.

Our long experience provides the answer for most any cable problem. If you have a *new* problem requiring a special solution, our engineers will be glad to work with you so that you can take full advantage of Kerite insulation.

Kerite made to the old formula is still used in our insulation. That is what makes Kerite cable such a good buy today . . . and why it gives such long service at low cost per year. The Kerite Company, 30 Church Street, New York 7, N. Y.

Kerite Insulation—Your Cable's Best Life Insurance

KERITE CABLE

Power Supply—An Economic A-Bomb

THERE'S A REALISTIC, if imprecise, figure in existence which indicates that the Reclamation Bureau and the Corps of Engineers may spend as much as $18,500,000,000 if they complete the projects they had on the books two years ago. While by no means all of this investment is for power facilities, every last dollar of it is tied inextricably to power. And there's about $3,000,000,000 of federal tax capital already invested in power.

Directly invested in privately owned electric power today is about $15,000,000,000. Long before the government spends any large part of that $18,500,000,000 for power-dependent water development, private capital will be in the private power business to the extent of at least $20,000,000,000. This leaves us with two huge pools of investment, divergently controlled, philosophically antagonistic. Everyone knows that large accumulations of capital strive mightily to protect themselves, perpetuate themselves, enlarge themselves. Some pretty bloody actions have been fought by masses of capital no larger and no more thoroughly opposed than are the federal government's prospective $21,500,000,000 in power-dependent facilities and private power's prospective $20,000,000,000.

A tidy, simple solution to the impasse posed here would be to let the contending amalgamation of capital fight it out. But that would be dangerous—much more so to the public than to the opposed investments. For the thing these two masses of capital have in common is much more important than the dollars themselves. It is this country's electric power supply. You may call power supply what you like—the magic wand that makes Twentieth Century America possible, the country's first line of defense in peace or war—but whatever you call it, power supply is infinitely more important than all the dollars invested in it. So a finish fight between the dollars invested in private power supply and those in federal power supply would damage far more than the dollars themselves.

This being so, hasn't the time arrived for all concerned to make certain that the problem is truly in focus? Does everyone who has any active part in matters affecting power supply realize that more than ideology or dollars is involved here? Does Congress know that its failure to do the power supply job it undertook in the Northwest has sentenced that region to a continuing shortage at least until 1952? Does utility management know that some of its best-informed expert employees indicate that the industry is flunking out today on power supply in another growing area of the United States? Do both parties realize clearly that dollars, and ideology, and ultimate triumph in the public-private ownership fight are trivial compared to the underlying concept—that of enough power to meet all the loads, safely and economically, at all times?

In expressing this concern, we're not being stampeded by the Truman-Krug-Wickard cries of shortage. (Both Truman and Wickard are uninformed about the subject. As for Krug, one can only guess that he knows it too well to talk as he does.) What worries us is whether the top echelons on each side—Congress and the power industry's directors—really understand that the ideological firecracker with which they're playing isn't that at all, but rather that it's an economic A-bomb.

Radiant Heating Reactions

SPECIAL RULES or riders have been added to residential rates by at least two Connecticut utilities in efforts to forestall trouble from house heating load. In that state, and probably in others, commercial exploitation of panel-type radiant heating is getting started. And from what we hear, that exploitation is not in every case adhering closely to the best standards of business ethics.

The difficulty in the situation arises from the fact that people are buying electrically heated houses under very wrong impressions of operating costs. These wrong impressions apparently derive from uninformed, or deliberately misleading, sales talks on the part of house sellers. Speculative builders are discovering they can install electric heating panels at a fraction of the cost of conventional fuel-burning systems.

Then they show the prospective buyer the lowest step in the residential electric rate and figure the heating bill on that, using, of course, the lowest possible figure for energy consumption. The buyer soon discovers that the estimate of energy use is much less than the actuality and that at present the utility is much less than enthusiastic over the load he has added to the lines. Also he may find that in northern winters panel heating has the deficiency but lacks the cheer of an open fire: it toasts one side and leaves the other cold.

That is why certain utility managers are thoughtfully adding certain modifications to their residential rate schedules, such as, for instance, a monthly demand charge of $2 per kilowatt of heating load when electricity is used for more than casual heating in the home.

It is hoped that such charges are completely justified in the cases where imposed. It would be unfortunate if panel electric house heating were discouraged to this extent in many areas at a time when great opportunities in this field lie on the threshold. Now is the time for all utilities to prepare adequate rates for the new electric loads, including not only heating but year-round air conditioning as well.

Certainly public education regarding the home heating systems is an immediate responsibility of utilities since they must serve the load.

Good Management Pays

EXPERTS HAVE BEEN advising the electric utility industry on financing problems rather steadily for the past year or more, helping the power business overcome the problems posed by raising new money from a bad market for a phenomenal expansion program. If there's been one refrain that has been sounded in all such advice, it has been this: "Do everything you can to get the best possible rating for your securities." The warning has been doubly meaningful because so much of the industry's financing has been done by debt issues, where ratings really become firm and perceptive.

We don't suppose that anything can happen to emphasize the validity of this advice from the financial community more than the recent sale of the $40,000,000 Duke Power debt issue. Duke had a triple A rating for its bonds. It drew bids from four major houses. The winner paid 100.803 for a 2¾ coupon. That's a premium not far below the average level at which most issues have been selling in recent months and a coupon a full quarter of a percent below the 3¼ rate which has been noticed often recently. It's hard to beat that kind of financing without going straight to the federal treasury, a source closed, today, to at least 80% of the industry.

One quarter of one percent on $40,000,000 over 30 years is a fancy reward for the management good enough to command a triple A rating for its bonds. It ought to be sufficient incentive for those managers who haven't yet won AAA ratings on their debt.

No Inference Intended

"LIKE I ALWAYS say, take it easy, bub, if you want to succeed in life. And that goes double for salesmen."

So begins a disquisition on the "Basic Principles of Good Salesmanship (?)" by Prof Sylvester Quarterwit, recently published by the National Electrical Wholesalers Association. The delicate inference of this piece—like the idea, "Guess I'm not wanted in there," received by the man thrown out on his ear—is that NEWA thinks its members' selling organizations need a little jacking up.

Of course, ELECTRICAL WORLD does not intend, from this mention of NEWA's four-page broadside, that any such inference be drawn in respect to utility sales organizations—not at all. But just in case there may be some in utility sales ranks not yet recovered from the "dolce far niente" of the sellers' market, we suggest that copies of Professor Quarterwit's remarks are available from the National Electrical Wholesalers Association, 500 Fifth Ave, New York 18, N. Y.

New Use for Bill Stuffers

WHENEVER YOU BUY a Pennsylvania Railroad ticket these days, you're likely to find in the envelope a small slip of paper notifying you that the price you just paid included a 15% federal tax. The paper notes also that "this tax was a World War II measure designed in part to discourage civilian travel. There is no longer any need from this standpoint to continue to impose this extra burden on you."

We don't know whether any power companies have been using bill stuffers to comment on the 3.3% gross energy sales tax, but it might be an idea. As we heard the story, when this tax was instituted back in the depression days considerable care was taken to write the law so as to forbid utilities from showing it on the bill as a federal tax. The motivation, of course, was punitive. Is there any law that says a utility can't enclose a bill stuffer discussing the tax?

The Electrical Week

Nationalization has proved to be no solution to the problems of the French power industry. Instead there is every indication that the problems will get worse since the bureaucrats are allowing the physical plant to decay . . . Far West utility plant construction is going on at a record pace. This year the total will be $270 million . . . At St. Louis, the Edison Electric Institute Electrical Equipment Committee was told that modernization, expansion, and reenforcement of bulk power systems are opportune . . . And at Pittsburgh, the Pennsylvania Electric Association learned that relaying can vary widely and still achieve comparable degrees of protection for equipment in power plants.

REA's official position on the Reynolds-WEC ACSR contract may be found in Administrator Wickard's talk before the recent NRECA convention. Said Wickard, "The Wisconsin Electric Coperative's contract with the Reynolds Metals Co for aluminum conductor offers a bright ray of hope on what otherwise is a darkening picture in this field. It deserves your careful consideration."

An investigation of Meter Department accidents by a utility revealed that the most common accident was the dog bite suffered by meter readers. Further investigation showed that the only victims were readers who did not like dogs. The utility is considering hiring only men who like dogs or else forcing each man hired to get a dog so that he will grow to like them.

The President and certain of his official family disagreed, in the messages they sent to the recent NRECA convention, as to how many farms were electrified when REA was organized. Mr Truman said one in nine; others, including Secretary Krug, said one in ten. But everybody agreed that seven in ten are electrified now.

Interior Department power policy, as stated by Secretary Krug, includes this: "Certainly, an essential part of our national power policy should be that our power supply must be sufficient to meet all the requirements of a full employment economy and provide reserves for all emergencies, whether those of an operating character or those threatening our national security and welfare."

An electrical worker, Kaare Hansen, president of the Oslo Federated Unions, was among a group of Norwegians who came here to study American production methods under sponsorship of the Economic Cooperation Administration. Hansen said Norway has developed only 15% of its potential power but plans considerable expansion.

In the last half of 1948, the Federal Power Commission authorized the construction of 2,203 miles of natural gas transmission pipeline. These facilities will increase the capacity of the nation's pipeline systems by more than 600,000,000 cu ft daily.

What should small electric appliances be called? The National Electrical Manufacturers Association is circulating a ballot which gives the voter four other choices: "portable electric appliances," electric traffic appliances," "electric housewares," or any other he may suggest.

The Merrimack Valley Authority proposed by Representative Lane of Massachusetts would be more than a TVA to New England. In addition to power generation, flood control, and navigation, the Lane proposal calls for reclamation work by his MVA to irrigate "family size" farms. The corporation—financed by the Treasury—also would supply municipal water and make loans to public agencies for irrigation and power projects.

While the membership of Edison Electric Institute was debating—and finally rejecting—an industry "public information program," the National Rural Electric Cooperative Association went ahead with its own version of the same thing. According to Past President Craddock, NRECA's "increased information program" arose primarily as a result of utility attempts to buy out member cooperatives. The program's big aim is member education.

British Columbia is likely to become the next big aluminum-refining center of the world. Both the Aluminum Co of Canada and Reynolds Metals Corp are considering establishing plants there.

Proudly, the IBEW claims to have contributed more money than any other union to the AFL Political League last year

Notes From The News

Caldwell, Ohio, is considering an offer of $85,000 made by the Ohio Power Co for the municipal light plant and franchise. Impetus is being offered by the need of new equipment worth $60,000 . . . The Elec-

Continued on following page

WHO PUT THE POTATO SACK in a 10-kva transformer of Arkansas Power & Light Co? That was the question employees of the utility asked when the transformer was returned for repairs

trical Women's Round Table, Inc, is mothering a new national organization, which will have chapters in other cities . . . The Illinois Central RR has just received the first all-electric dining car. All cooking will be done by electricity. In addition there will be an electric garbage disposer, electric refrigeration, and an electric dishwasher . . . The new 26-story John Hancock Mutual Life Building in Boston has escalators connecting all floors between the basement and the eighth. In the morning rush hours the escalators move employees upward. In the evening, they are reversed to carry employees to the lower floors . . . Rent charged AEC employees at Hanford for four-bedroom homes is only $57.50 a month with all utilities included. Congress feels that an investigation is in order . . . With the end of the power shortage in Ontario, lighting of Niagara Falls has been resumed . . . Memphis Light, Gas & Water commissioners want their employees excluded from Civil Service because they feel full control of their employees is necessary.

Because of improved water conditions, the Salt River Valley Water Users Association has relaxed some of its controls on use of water for irrigation . . . Georgia Power Co is again sponsoring a hybrid corn growing contest for 4-H members . . . Louis C. Spencer, manager of the Delta Electric Power Association, a cooperative, has been named the outstanding young man of 1948 by the Missouri State Junior Chamber of Commerce . . . Because the Central Illinois Public Service Co said that it would buy 100,000 tons of coal annually from Christian County mines if it could get the same freight rates that apply to shipments from Fulton County, the Illinois Commerce Commission has authorized a reduction in freight rates to 90¢ a ton . . . Grand Coulee believes it set a world's record for hydro-electric generation in January when 838,278,000 kwhr were produced. A new daily record was established Jan 29 with 27,397,000 kwhr.

Assets of the New England Electric System, a holding company, have been released from jurisdiction of the Federal District Court at Boston . . . Coal towing is again likely to become a regular business on the Kentucky and Green Rivers in western Kentucky. The reason is that the Tyrone Plant of Kentucky Utilities Co could use coal, which would be cheaper in cost . . . Swifton Power & Light Co has been incorporated at Tuckerman, Ark. . . . W. B. Wolfendale, veteran engineer of Seattle City Light and the man in charge of building Ross Dam, has retired after 31 years' service . . . The Pacific Northwest, especially Oregon, is fearful of spring floods . . . Development of Lewis County, Wash., coal beds to supply fuel for thermal plants in the Northwest is being advocated . . . A Norwegian firm claims to be producing aluminum 99.996% pure, the purest in the world.

Legislation:

Washington has passed a law which reserves as fish sanctuaries all rivers in western Washington tributary to the Lower Columbia. Immediate effect will be to stop Tacoma from building two hydro plants on the Coulitz River . . . Although Manitoba has plans for public ownership of hydroelectric resources in the province, it is unlikely that any legislation to further this aim will be introduced this year . . . A bill has been introduced in the New York Senate to bar electric utilities from manufacturing or selling appliances . . . The Indiana House has passed a bill repealing the compulsory utility arbitration law. The Senate is now studying the bill.

Construction:

Ontario Hydro-Electric Power Commission will build a 206,000-hp steam plant at Toronto . . . Central Louisiana Electric Co will erect a 10,000-kw unit at its St. Landry Plant . . . Ohio Edison Co has purchased a 77-acre site for a future power plant at Stratton, Ohio . . . British Columbia Electric Railway Co has announced that the second 62,000-hp unit scheduled for operation this month in its Bridge River Plant won't be available for two months. Bad weather and equipment delays are blamed. The first unit was installed months ahead . . . Gulf States Utilities Co will spend $27,896 during 1949 on construction projects.

French Nationalization Failing Test

Power Industry Not Maintaining Equipment; Building Program Lags; Price of Energy Soars; Operations Hampered by Paris Bureaucracy and Politics

By Boyd France
(McGraw-Hill World News)

PARIS — Nationalization in France meets its most clear-cut test in the electric power industry. So far, it's flunking.

Electricite de France is the pride of the nationalizers. They point to its huge expansion, to its 48% boost in output over 1938. That they do so is neither surprising nor the whole truth.

EdeF inherited a sound foundation on which to build. Unlike many other French industries, the power business was progressive, profitable, well-run. It was expanding—out of earnings. So the nationalizers had only to pick up the reins and drive—toward a market which, in coal-short France, seemed as bright as any in Europe.

One Way to Break Even

Since taking over, EdeF hasn't flopped—but it hasn't succeeded, either. It's still in the red after two and one half years. And its capital expansion is furnished by the state. EdeF says it broke even last year on normal operating expenses, excluding new investment. The books show it did so by neglecting replacement and maintenance to the tune of 5 billion francs. Figuring that in, a loss close to 1947's 5.2 billion francs can be expected. EdeF explains that it was forced to operate old thermal plants on coal that cost 19 times its prewar price. And it cites a 30% wage boost won during the year.

Conversely, rates went from 1.5 francs per kwhr before the war to 18 francs now. Increased load factors weren't enough to keep rates down. Before the war, under private management, the industry showed a comfortable profit, devoted 30% of gross to re-equipment and new investment, and financed independently an expansion nearly as ambitious as its present program.

The Causes of Inefficiency

EdeF's inefficiency today springs from four main sources:

1. Overcentralization—There's a top-heavy bureaucracy in Paris, despite the promise of the nationalizers that they would smash the electrical monoply into efficient, flexible regional units. The opposite took place when local employees were fired wholesale for political reasons, replaced only after long delays. Local operations were run from Paris during the interim, a habit which remains today, with local people reluctant to assume either authority or responsibility.

2. High wages—French standards don't justify the average EdeF wage of 400,000 francs (roughly $1,000) yearly. It's 25% above the national average.

3. Communist troubles—EdeF was seized by the Communist-led CGT on nationalization. Thousands of non-Communist employees were purged, and CGT got a hand in management through strong representation on France's version of the "management-labor" committees, which were established after nationalization. CGT has now been eradicated from top level jobs. But it still has substantial influence, which it uses to oppose the Marshall Plan.

4. Politics—With important jobs in the power system being treated as political plums, the authority of operating officials was further weakened. First the CGT, later more moderate parties, began firing directors who made decisions which were politically unpalatable.

VINCENT AURIOL, French president, pointing to one of the turbines of the Genissiat hydroelectric project on the Upper Rhone, gets some information on a tour of EdeF's properties

One of the things that shocks the nationalizers is the fact that the capital expansion program has been hit so hard. They had achieved nationalization, in part, by warning that the expansion was too big to be handled privately. In 1947, EdeF spent about 40 billion francs, raised output about 1.5 billion kwhr. The program was cut back last year, because of financing troubles. Labor employed on new construction dropped from 45,000 to 36,000. Output went up 2.4 billion kwhr, at a cost of 60 billion francs.

But most of the new stations which went in during the last two years had been blueprinted—even started—long before nationalization. The expansion for which EdeF may properly take credit during the last two years is about 1.8 billion kwhr yearly. It isn't enough,

W. H. KAISER, left, New England District manager, General Electric Supply Corp, congratulates his successor as president of the Electric Institute of Boston, Frederick P. Coffey, president, Anderson-Coffey Co. Lending their support are two former EIB presidents, Frank L. Nason, Westinghouse Electric Corp, and Alan Steinert, The Eastern Co

by 1 billion kwhr annually, for French consumption now is doubling every 10 years. And as things stand, EdeF can't raise the capital required to step up the expansion program. It's been trying to drum up private investment for two years, but practically all the new money comes from the state. And the state isn't in very good shape to spend for power. ECA is insisting on a balanced budget and a stable franc.

Now Edef is spending 10% of gross on expansion, replacement, debt service, etc. Before the war it was 30%. As for private capital, there's plenty around. Experts say EdeF ought to be able to raise 500 billion francs yearly—with sound management. They point out that if EdeF could spend 20% of its 130 billion francs gross for debt services, rather than the 10% it now can spend, it could support 500 billion frances of private investment at 5%.

But investors remember that they were burned when the nationalization took place. (Some estimate that the equity shareholders lost 60% of the value of their shares in the indemnification process.) And EdeF's rate tactics scare investors, too. It froze rates during the 1947 inflation, doubled them in 1948 when prices flattened. Then too, the wild spree of nationalization in which France engaged shook the faith of French business in the future of the economy. All these factors make risk capital eye EdeF suspiciously.

So far as labor-management strife is concerned, nationalization hasn't been the perfect answer by any means. Nationalized industries, in the aggregate, have been strike bound 53% longer than private industry since the war's end. And instead of having worker-management strife in one industry, or a part of it, the nation now has government-working class strife on a national plane. The Communists have tasted enough power to want a lot more.

The Communists admit their nationalization experiment hasn't succeeded but say you must nationalize everything to have it work at all.

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Arkansas P&L Expansion to Cost $24,500,000 in '49

A $24,500,000 expenditure is called for in Arkansas Power & Light Co's 1949 construction budget as part of an $88,000,000, six-year building plan scheduled for completion in 1952.

Expansion now under way on three AP&L plants will provide 280,000 kw of new generating capacity. This power will be provided by the additional 60,000-kw generator at the Cecil Lynch plant in Little Rock, the 88,000-kw Lake Catherine plant, and the new Eastern Arkansas 132,000-kw plant to be constructed near Forrest City.

Proposed expenditures for 1949 include $12,000,000 for new generating facilities, $3,300,000 for transmission facilities, $2,000,000 for substations, and $6,600,000 for improving distribution facilities.

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Ontario Buys 15 Units

Fifteen steam and diesel-powered electric generating plants have been purchased by the Ontario Hydro Commission for installation in southern Ontario. Largest will be a 120,000-kw plant at Windsor. The province still faces a weekly shortage of 9,395,000 kwhr, A. W. Manby, assistant general manager of administration for the Commission, warned.

PEA Group Discusses Power Plant Relaying

That relaying can vary widely and still achieve comparable degrees of protection for equipment in power stations was shown in a symposium conducted by the newly constituted Relay Committee of the Pennsylvania Electric Association at Pittsburgh Feb 17 and 18. The group discussed the details of Phillips (Duquesne Light Co), Hunlock (Luzerne County Gas & Electric Corp), Sunbury (Pennsylvania Power & Light Co), and Mitchell (West Penn Power Co) stations.

Several types of generator neutral grounding were cited, in the talks, and the factors affecting the choice were enumerated by A. A. Johnson, Westinghouse Electric Corp. Effects on protective relaying were brought out by A. J. McConnell, General Electric Co, particularly the sacrifice in sensitivity of ground-fault relaying if the neutral impedance is relatively high. Johnson had stressed the growing tendency to choose grounding and protective schemes that definitely limit generator damage during faults.

Resistance Across Secondary

Several of the schemes reported use distribution transformers with resistance across the secondary for neutral grounding. Duquesne Light matches the resistor ohms to the possible capacitive impedance. McConnell urged that relay engineers be called to participate at the early stages of station design to avoid being confronted with "frozen setups" hard to relay later in construction.

Sunbury generators, according to J. A. G. Oewel, are to have protection against field failure, motoring, and phase unbalance. The 66-kv buses will have linear coupler relaying. Mitchell Station relaying, said K. N. Reardon, is minimized for simplicity, with synchronizing control within the plant but most other external functions controlled from system operating headquarters.

Double Use of Curves

Incidental discussion of current transformer characteristics and connection limitations prompted R. E. Cordray, GE, to doubt whether enough utilities really use the available curves in their relay analyses.

In a luncheon talk, G. W. Ousler, vice-president of Duquesne Light, expressed hope that engineers would take interest in the load-building programs of the future and, even now, be prepared with facts to refute such casual remarks as "electric cooking is too expensive."

CALIFORNIA'S power supply will get a 126,000-kw boost when this Pacific Gas & Electric Co Rock Creek Plant on Feather River is completed in 1951. This plant is part of a $35,400,000 project which includes a diversion dam and a 6½-mile, 25-ft tunnel. Penstocks will be placed under structure at left, designed for a highway, with space for circuit breakers and step-up transformers on top. A similar 75,000-kw project is underway downstream

Western Utilities to Spend Almost $270 Million in 1949 on Expansion

PRIVATE UTILITIES in the Far West will spend nearly $270 million this year in postwar construction programs that so far have added some 645,000 kw of generating capacity and are slated to boost power supplies by another 1,700,000 kw by 1953.

An ELECTRICAL WORLD survey of nine utilities showed that most of them were maintaining record-breaking construction schedules to keep ahead of the demands created by the area's continuing expansion.

Topping the list is the Pacific Gas & Electric Co, which has budgeted $150 million for construction in 1949 that will put another 215,000 kw "on the line" in its system. A second 110,000-kw generator at Station P in San Francisco, a new 75,000-kw Cresta powerhouse on the Feather River, and a 30,000-kw Colgate plant on the Yuba River will be installed.

Last year the company added 300,000 kw to its steam and hydro capacity as part of a postwar building blueprint that will increase its facilities by 1951 by some 1,350,000 kw.

Southern California Edison Co is planning to invest $74 million in system improvements in 1949. About half of the amount will go for distribution lines and substations. Plans for the year include the installation of two additional 66,000-kw turbo-generators at Redondo steam plant, the construction of 23 new substations, and the addition of 850 miles of transmission and distribution lines.

The company has just applied to FPC for a license to construct and operate a new $20 million 84,000-kw powerhouse on the San Joaquin River, Big Creek Power house No. 4. SCE put 167,000 kw in new generating facilities into service last year, the first two units at Redondo Beach and a new unit at Big Creek No. 3, bringing its postwar additions to date to 189,500 kw.

Utah Power & Light Co will increase its output 82% over the next five years at a cost of $61 million. About half the capital investment will go for coal-burning steam generating plants and the other half for substations, transmission and distribution lines, and other equipment.

Planned are a 43,000-kw addition to the company's present Orem steam plant at the mouth of Provo Canyon, scheduled for operation early in 1950, and a 63,000-kw addition to the Jordan steam plant in Salt Lake City, to be completed in September, 1951. A twin unit will be installed at the Jordan plant in 1953.

Idaho Power Co, which has added 37,200 kw since the war, will put 60,000 kw into service this year at its plant at Lower Salmon Falls on the Snake River and 70,000 kw at its Bliss Plant on that river in 1950. Its overall program is costing about $30 million and will increase the system's capacity one and one half times over the prewar total.

The San Diego Gas & Electric Co, which has added a 50,000-kw unit at its Silver Gate plant since the end of the war, has a similar unit there due for completion in 1950. These cost about $6 million each. Plans for a third have been announced, although a site has not been chosen. The company will spend also about $4,500,000 this year for 230 miles of transmission and distribution lines and ten major substations.

Central Arizona Light & Power Co will spend $10 million this year to expand its generating facilities. The company has added 30,000 kw since the war and plans to increase that to 60,000 kw by 1950. Arizona Edison, which has added 4,445 kw since the war, has under construction facilities to supply 7,500 kw more. The company will spend $1,750,000 this year.

The Public Service Co of New Mexico plans expenditures of about $3 million in 1949, for a new $1,000,000 plant in Santa Fe, a new dam at Las Vegas to increase water storage, and for distribution lines at Albuquerque. The company has added 19,000 kw since the war, an 11,500-kw and a 6,000-kw generator at Albuquerque and a 1,500-kw unit at Las Vegas.

Pacific Power & Light Co will spend about $3 million this year to complete installation of a 4,500-kw generator at Merwin Dam on the Lewis River in southwestern Washington. The new facility will bring the company's postwar expansion to 5,500 kw.

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Georgia Power Abandons Action Against Clark Hill

Georgia Power Co has dropped all actions, other than land condemnation proceedings, against Clark Hill multipurpose project.

Georgia Power had asked the right to construct the power plant at the dam and to pay the government for the water used. The company now intends to seek agreement for Georgia Power to distribute the power in the same manner as stipulated in the contract made for power at Allatoona Dam, at Cartersville, 40 miles northwest of Atlanta.

Georgia Power believes that the government will receive a better return on its investment by having the power distributed over present facilities. The utility has the steam plants to firm the power.

AT HOLYOKE, MASS., where Holyoke Water Power Co and the Holyoke Gas & Electric Department both wish to develop the Connecticut River, M. G. Baron, Federal Power Commission examiner, has been conducting hearings. Taking an active part have been R. E. Barrett, Jr, left, president, Holyoke Water Power; W. W. Gatchell, assistant chief counsel, and Joseph Hayden, Bureau of Power, FPC; and F. H. King, manager of the municipal

EEI Equipment Group Told Time Is Opportune to Modernize Systems

MODERNIZATION, expansion, and reenforcement of bulk power systems are opportune at present, according to speakers at the meetings of the Edison Electric Institute Electrical Equipment Committee at St. Louis Feb 14 and 15.

Present and prospective demands warrant comprehensive decisions often involving large departure from the piecemeal pattern of evolution previously followed. Minneapolis and St. Louis are both to have close in loops (138 and 115 kv, respectively) to bolster the metropolitan supply. The lines in built-up areas are largely to be on railroad rights of way, according to C. G. Dewars and E. L. Hough, of Northern States Power Co and Union Electric Co of Missouri, respectively.

Changeover to 60 cycles by Southern California Edison Co was completed in three instead of five years but at a cost practically 70% greater than originally estimated. The system has an unusually high proportion of corrective kilovars, according to Lloyd F. Hunt—800,000 of synchronous condensers and 300,000 of capacitors against a generation total of 1,600,000. Out-of-step protection affording one second separation has permitted operation close to the transient stability limit. Carrier is less effective for the short distances between substations than instantaneous ground and phase protection of the 220-kv links, according to Hunt. An extensive system of telemetering is being worked out.

Satisfactorily accurate measurement of daylight is possible with a new photronic cell developed by the Weather Bureau and Bureau of Standards. Success, according to W. F. Davidson, Consolidated Edison Co, New York, hinged largely on perfection of the diffusing pickup to register the incident light right up to sunset.

Sentiment was expressed by the group in favor of retaining in the transformer standards the provision of load-back testing. It was stated that only the short circut test had been retained in the current draft.

Considerable diversity of practice and of attitude was reflected in a discussion of methods for extinguishing fires in electric stations and equipment. Comment on a paper by N. L. Clarine relating the policy of Southern California Edison indicated that Philadelphia Electric Co and Pennsylvania Power & Light Co prefer water in foam and spray and chemicals to carbon dioxide. Carbon dioxide is the major reliance at the California utility's hydro, condenser, and unattended substations.

A survey of 38 utilities disclosed 330 water spray installations, for 200 of which the control is automatic. Only four consider direction upon energized equipment hazardous, practically none have had flashover, and few worry about rust accumulations in the spray-system piping.

E. S. Fitz, Virginia Electric & Power Co, who guided the symposium, said one of the worst fire hazards exists during construction operations, when the protection is usually a minimum unless assured in advance.

S. C. Townsend, Pennsylvania P & L, presented data supporting the stipulation of the following minimum distances for spray-nozzle clearance: 220 kv, 18 ft; 66 kv, 8 ft; 12 kv, 3 ft. Boston Edison Co requires substation operators to work once a year for 15 minutes with gas masks on; the masks are designed to permit the user to wear his eyeglasses.

Dissatisfaction was expressed with the policy of motor manufacturers in offering only ball bearing motors in certain sizes required for power station auxiliaries. The "10,000-hour life" factor of the ball bearings is not considered adequate for the often year-round operation of the substation auxiliaries.

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Demand Charge Added for Exceptional Loads

Modifications specifying a $2-per-kw monthly demand charge for exceptional loads have been added to residential rate schedules by two Connecticut utilities, Hartford Electric Light Co and Danbury & Bethel Gas & Electric Light Co. Purpose of the riders is to avoid the discrimination against other customers that would result if some were allowed extraordinary use of electricity, as in house heating, on the regular residential rate.

A "temporary rate for space heating in dwellings" became effective Jan 20 in Hartford. It applies to residences in which electricity is the principal heat source. A separate meter is required. The rate is composed of a monthly demand charge of $2 per kw and an energy charge of 2¢ per kwhr.

The Danbury & Bethel revision went into effect Dec 20, 1948. A special rule added to the residential schedule reads, "If electricity is used as a major source of energy for heating, or a motor is installed with a rating greater than 5 hp, there will be a yearly demand charge of $24 per kw, payable monthly, on the demand in excess of 4 kw."

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Rural Lines to Be Added

Central Louisiana Electric Co has started preliminary work on construction, to cost approximately $390,000, of 250 miles of rural lines in five parishes. A new 10,000-kw, $1,500,000 generator will be added to the St. Landry generating station. The company's total construction bill for 1949 will be more than $2,000,000.

ELECTRICITY FOR ALUMINUM production was assured Feb 14, when Pres C. Hamilton Moses (with glasses) of Arkansas Power & Light Co signed a contract with Reynolds Metals Co. At left is Walter F. Rice, vice-president of Reynolds. At right is Gov Sid McMath, in whose office contract was signed. Standing is Keene Johnson, Reynolds vice-president

AP&L to Sell Reynolds Power for Third Potline

Arkansas Power & Light Co has contracted with Reynolds Metals Co to supply 37,500 kw of interim power for the operation of a third potline at the Jones Mill aluminum reduction plant, which Reynolds is operating under federal government lease.

Under terms of the contract, Reynolds will begin taking power for the potline not later than 60 days after the date of the contract.

Reynolds officials estimated that the output of the Jones Mill plant will be increased from 6 to 9 million lb of aluminum daily when the new potline gets to operating. Power for the two lines now in operation is coming from gas-fired, engine-driven d-c generators at the plant. A fourth potline at the plant will not be started until the utility completes its Lake Catherine steam-electric plant near the aluminum plant.

AP&L has contracted to sell Reynolds 30,000 kw out of the new Lake Catherine station.

In order to replace power which it had contracted to supply Reynolds during the interim period, AP&L has contracted with Grand River Dam Authority of Oklahoma to purchase 20,000 kw of firm energy from the state authority, the bulk of it to come from the Choteau, Okla., generating plant at the former Oklahoma Ordnance Works.

AP&L has also been notified by Southwestern Power Administration that the contract between AP&L and SPA for power from Norfork Dam will be extended to Jan 1, 1950.

Reynolds agreed in the contract to sell AP&L any and all surplus power and energy generated at its Hurricane Creek alumina plant.

During negotiations for the interim power for the Reynolds plant it was disclosed that Grand River Dam Authority has on order and plans to install a new 10,000-kw generator in the Choteau plant to be operated in lieu of two 5,000-kw non-condensing units now in operation. Delivery of this generator is scheduled for June.

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Kansas City P&L Plans to Build $27 Million Plant

Kansas City Power & Light Co will erect a $27,000,000 generating plant that will increase capacity about 40%. The sum of $3,000,000 will be expended in 1949, $15,000,000 in 1950, and $8,000,000 in 1951.

The company has exercised its option to purchase 660 acres of land along the Missouri River from the Truman Bridge to the mouth of Blue River. The site is adjacent to Kansas City's northeast industrial district and about two miles from the Blue Valley industrial area. It will have flood protection from the Missouri River under direction of the U. S. Army Engineers. The plant itself will occupy about 100 acres. Construction work will begin next spring.

The 132,000-kw steam-electric generator will be placed in full service by 1951. Generation will begin with two units, a 66,000-kw one to be completed in April, 1951, and another of the same size about two months later.

Power Mission to Study German Decartelization

Two operating electric utility men and a state regulator will leave for Germany next week to study and make recommendations on the divorcement of German power supply systems from allied industrial and coal mining interests.

Heading the latest mission will be Pres James W. Parker, of Detroit Edison Co. Assisting him will be George Steinmetz, chief engineer of the Wisconsin Public Service Commission, and Alois Hoefle, superintendent of the system operating department of Toledo Edison Co. Their mission was organized at the request of Gen Lucius Clay, U. S. Military Governor in Germany. It is part of a program aimed at decartelization of industry in Western Germany.

The three men are expected to be away about eight weeks. Their study arises out of a decision to push forward with the activities called for under Military Government Law No. 75. Promulgated late last fall, this edict aims at decartelization of the industrial combines under Allied control in Germany. Power systems there are so tied in with other industries, particularly coal mining, that expert opinion is considered necessary as to the extent to which they can be separated. The Parker group will advise as to policy and recommend what steps may safely be taken, in the light of the serious power supply situation that now exists.

Hoefle brings considerable experience with German power supply to the problem. He served on the staff of Col Walker L. Cisler during the war and early postwar period, when the Allies were rehabilitating European power systems. Steinmetz was a major in the Corps of Engineers during the last war, serving primarily in the War Department's power supply group handling power contract renegotiation. Parker recently completed more than a year's advisory service as chairman of a committee advising the Atomic Energy Commission on industrial participation in the atomic program.

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Kentucky Plant Doubled

Kentucky Utilities Co, which is adding to its generating capacity at several points, has arranged to double capacity of its Four Mile operation near Pineville, Ky., by installation of a new 30,000-kw unit. The plant is in the southeastern Kentucky coal mining district adjacent to the Harlan and Hazard fields.

House Votes Indicate Public Power Support

With this session's House of Representatives, it's public power, by almost 2 to 1. That's what last week's (Feb 16) votes on the power sections of the deficiency appropriation bill showed.

Four specific power votes were taken during the bill's progress through the House, including:

1. A 105-192 defeat for an amendment junking TVA's New Johnsonville steam plant.

2. A 63-116 defeat for an amendment retaining limitations on Bonneville construction and publicity work.

3. A 62-117 defeat for proposed Reclamation Bureau engineering and personnel limitations.

4. An 87-136 defeat for an amendment keeping the Straus-Boke rider approved last year.

The House approved deficiency appropriations for power agencies exactly as recommended by its Appropriations Committee. The Senate isn't expected to rock any boat when it gets the deficiency bill.

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Cleveland Electric Group Elects Head as President

A. F. Head, district manager, General Electric Supply Corp. has been elected president of the Electrical League of Cleveland.

Other new officers are Will T. Clark, residential sales manager, Cleveland Electric Illuminating Co, executive vice-president; and Frank J. Hopperton, president, Elliott Electric Co, and K. R. Schuele, vice-president, Fries & Schuele Co, vice-presidents.

J. E. North, who served as president of the league for 26 consecutive years, was elected honorary president. Stanley E. Strunk was re-elected secretary-treasurer.

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Cordova to Buy Plant

Cordova, Alaska, has begun negotiations leading toward purchase of the plants and distribution facilities of the Alaska Public Utilities, now serving the city. The company's franchise gives the town an option to purchase upon giving a year's notice of intention. The town also is interested in developing a hydroelectric plant on Power Creek, about 7 miles from Cordova. It has asked Delegate E. L. Bartlett to include the community in a bill before Congress which would authorize the Interior Department to construct and maintain power projects in Alaska for the benefit of communities affected.

SEC RULINGS

Atlantic City (N. J.) Electric Co has received authorization to borrow $850,000 to be used in the payment of $500,000 of notes and the balance added to general treasury funds. The borrowing is to be made in equal amounts from Guaranty Trust Co of New York and the Irving Trust Co and will be represented by promissory notes maturing Dec 31, 1950, and bearing interest at the rate of 1¼% until July 11, 1949, and thereafter at 1½%. The borrowing is being made under a credit agreement with the banks pursuant to which $2,750,000 previously was borrowed since July 11, 1947. (Release No. 8818).

Union Electric Co of Missouri has obtained a further postponement from Feb 15 to April 19 of the hearing on the proposed sale of an additional 367,500 shares of its common stock to The North American Co. The postponement had been requested by the companies. (Release No. 8819).

Central Maine Power Co has received authorization to issue and sell 286,496 additional shares of its common stock, $10 par, proceeds of which are to be applied to reduction of short-term bank borrowings for construction purposes. The stock is to be offered for subscription by common and 6% preferred stockholders of the company on the basis of one-sixth of a share for each share of outstanding common and five-sixths of a share for each share of outstanding 6% preferred. New England Public Service Co, which owns 77.8% of the outstanding Central Maine common, will waive its subscription rights to 219,196 of the new shares. These shares, plus any of the remaining 67,300 shares not purchased by stockholders, will be sold to underwriters. (Release No. 8820).

United Light & Railways Co has received authorization to make an offering to its common stockholders of 634,667 shares of its holdings of 1,268,698 shares of common stock ($25 par) of American Light & Traction Co, at a subscription price of $12 per share. Both companies are located in Chicago. The offering is based upon one share of American Light stock for each five shares of Railways stock owned on the record date, Feb 7, 1949. The balance of the American Light stock is to be offered for sale to Railways' stockholders at a later date. Net proceeds of the stock sale are to be applied by Railways to the payment of notes which were outstanding in the amount of $12,250,000 on Dec 31, 1948. (Release No. 8831).

Minnesota Power & Light Co has been permitted to make an offering of 59,090 additional shares of its common stock to its common stockholders of record Feb 3. The subscription price will be $21 a share. American Power & Light Co will exercise its right to buy 50,000 shares of the offering at a total subscription price of $1,050,000. Minnesota Power will use proceeds for construction. (Release No. 8828).

MEETINGS

American Society for Testing Materials—Spring Meeting, and Committee Week, Edgewater Beach Hotel, Chicago, February 28-March 4; Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, June 27-July 1.

Exposition of Electrical Progress—Municipal Auditorium, Kansas City, Mo., March 2-6.

Pennsylvania Electric Association—Spring Meeting, Electrical Equipment Committee, Benjamin Franklin Hotel, Philadelphia, Pa., March 3-4; Spring Meeting, Communications Committee, Hotel Brunswick, Lancaster, Pa., March 31-April 1; Spring Meeting, Meter Committee, Abraham Lincoln Hotel, Reading, Pa., May 19-20.*

Interstate Power Club of New York—Spring Meeting, Hotel Martinique, New York, March 7.

Missouri Valley Electrical Association—Accounting Committee, March 7; Engineering Conference, April 6-8; Rural Roundtable, May 4, Sales & Rural Conference, May 5-6; Accounting Conference, May 12-13; Annual Meeting, May 17. All meetings at the Hotel President, Kansas City, Mo.

Institute of Radio Engineers—National Convention and Exposition, Hotel Commodore and Grand Central Palace, New York, March 7-10.

National Electrical Manufacturers Association—Winter Convention, Edgewater Beach Hotel, Chicago, March 13-18.

Conference for Protective Relay Engineers—Texas A & M College, College Station, Tex., March 14-16.

Oklahoma Utilities Association—Annual Convention, Hotel Tulsa, Tulsa, March 17-18.

Southeastern Electric Exchange—Engineering & Operation Section, General Oglethorpe Hotel, Savannah, Ga., March 24-25; Annual Conference, Boca-Raton Club, Boca Raton, Fla., April 13-15.

International Lighting Exposition and Conference—Stevens Hotel, Chicago, March 29-April 1.

Edison Electric Institute—Annual Sales Conference, Edgewater Beach Hotel, Chicago, April 5-7; Engineering Committee, Edgewater Beach Hotel, Chicago, May 2-4; Annual Meeting, Traymore Hotel, Atlantic City, May 31-June 2.

American Institute of Electrical Engineers—Conference on the Industrial Application of Electron Tubes, Statler Hotel, Buffalo, N. Y. April 11-12; South West District, Baker Hotel, Dallas, Texas, April 19-21.

National Association of Corrosion Engineers—Annual Conference and Exhibition, Netherland Plaza Hotel, Cincinnati, April 11-14.

Western Metal Congress & Exposition—Shrine Convention Hall, Los Angeles, April 11-15.

Midwest Power Conference—Sherman Hotel, Chicago, April 18-20.

National Electrical Wholesalers Association—Annual Convention, Netherland Plaza Hotel, Cincinnati, Ohio, May 1-6.

Indiana Electric Association—Annual Young Men's Utility Conference, Ipalco Hall, Indianapolis, May 2-3.*

American Society of Mechanical Engineers—Spring Meeting, Hotel Mohican, New London, Conn., May 2-4.

Electrochemical Society—Spring Meeting, Benjamin Franklin Hotel, Philadelphia, Pa., May 4-7.

American Public Power Association—Annual Convention, Ambassador Hotel, Los Angeles, Calif., May 10-12.*

Instrument Society of America—Spring Meeting, Royal York Hotel, Toronto, Canada, May 12-13.

National Fire Protection Association — Annual Meeting, Fairmont Hotel, San Francisco, Calif., May 16-19.

* Additions this week.

November Energy Sales Rose 10.4% Over '47

Sales of electric energy to utlimate customers in November, 1948, totaled 20,677,615,000 kwhr, the Edison Electric Institute reports. This was a 10.4% increase over the 18,726,158,000 kwhr sold in November, 1947.

Revenues from ultimate customers amounted to $375,038,200 in November, compared with $335,687,200 in November, 1947, an increase of 11.7%.

For the 12 months ended November 30, the average use per customer advanced to 1,551 kwhr from 1,426 kwhr for the preceding year, an increase of 8.8%; the average annual bill to $46.69 from $44.21, an increase of 5.6%; revenue per kwhr dropped to 3.01¢ from 3.10¢, a decrease of 2.9%.

Classification of Sales, November

Kilowatthour Sales November	Million Kwhr 1948	1947	Percent Change
Residential or domestic	4,495	3,876	+16.0
Rural (Distinct rural rates)	487	383	+27.4
Commercial or industrial			
Small light and power	3,651	3,346	+ 9.1
Large light and power	10,673	9,757	+ 9.4
Street & highway lighting	251	234	+ 7.5
Other public authorities	540	502	+ 7.7
Railways and railroads			
Street & interurban	325	359	− 9.5
Electrified steam railroads	207	219	− 5.3
Interdepartmental	48	51	− 6.5
Total to ultimate customers	20,678	18,726	+10.4

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Canadian Output Statistics

The Dominion Bureau of Statistics has released the following statistics of Canadian central stations. The figures are thousands of kilowatt hours:

Period	1948	1947
Eleven months	40,931,797	41,256,633
Primary	38,474,677	35,257,360
Secondary	2,457,120	5,999,273
Primary Consumption	37,249,396	33,986,619
Exports to U. S.	1,519,871	1,889,348
November	3,638,095	3,613,726
Primary	3,507,087	3,330,741
Secondary	131,008	282,985
Primary Consumption	3,391,518	3,227,370
Exports to U. S.	119,654	121,333
October	3,780,796	3,862,696
Primary	3,656,151	3,406,198
Secondary	124,645	456,498
Primary Consumption	3,544,201	3,296,972
Exports to U. S.	122,314	131,563

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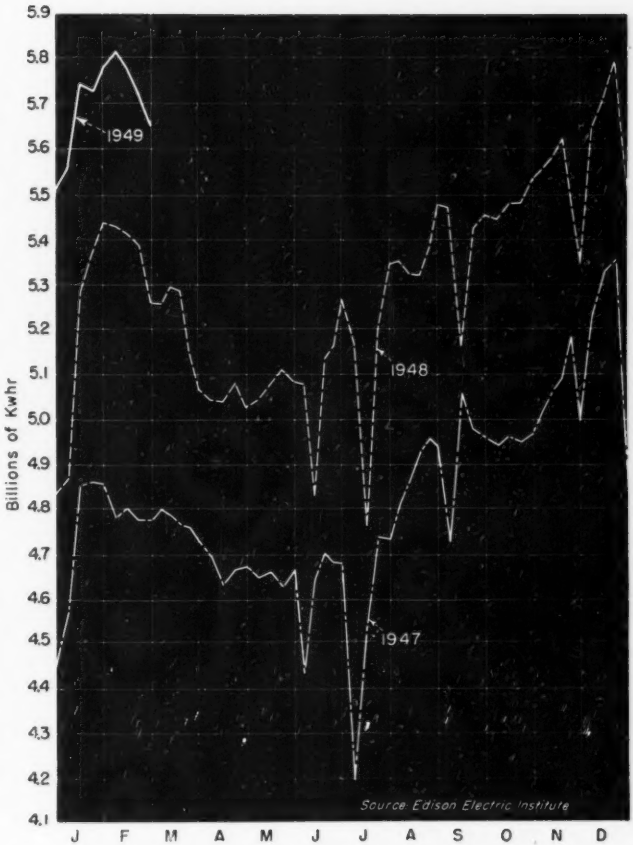
Salem to Tax Utilities

A license tax on electric utilities amounting to approximately 3% on gross earnings within the city has been passed by the Salem, Ore., City Council. It applies to Portland General Electric Co and the Salem Electric, a co-operative.



Output Continues Seasonal Decline

Following the usual seasonal trend, the output moved downward for the third consecutive week during the week ended Feb 19, 1949, reaching the lowest point since the first week in January of this year.

Edison Electric Institute reports that the amount of electrical energy distributed by the light and power companies of the country during the week ended Feb 19 totaled 5,650,279,000 kwhr, against 5,722,086,000 kwhr during the preceding week. The total compares with 5,254,002,000 kwhr for the corresponding week of 1948, ended on Feb 21, this year's figure representing an increase of 7.5%.

New England remained in the minus column, with a drop of 1.5% for the week ended Feb 19 as compared with the previous year, cutting the decrease to that figure from a drop of 2.8% for the week ended Feb 12. All the other geographical regions of the country reported higher percent changes during the week ended Feb 19 than during the week ended Feb 12, with the exception of the Pacific Coast States, which held firm at 6.8%.

Weekly Output, Millions Kwhr

1949		1948		1947	
Feb 19	5,650	Feb 21	5,254	Feb 22	4,778
Feb 12	5,722	Feb 14	5,385	Feb 15	4,778
Feb 5	5,778	Feb 7	5,412	Feb 8	4,801
Jan 29	5,810	Jan 31	5,429	Feb 1	4,777
Jan 22	5,769	Jan 24	5,436	Jan 25	4,856
Jan 15	5,727	Jan 17	5,370	Jan 18	4,857
Jan 8	5,742	Jan 10	5,278	Jan 11	4,853
Jan 1	5,562	Jan 3	4,868	Jan 4	4,574
1948		1947		1946	
Dec 25	5,508	Dec 27	4,830	Dec 28	4,442
Dec 18	5,790	Dec 20	5,368	Dec 21	4,940
Dec 11	5,705	Dec 13	5,327	Dec 14	4,778
Dec 4	5,646	Dec 6	5,218	Dec 7	4,673

Percent Change from Previous Year

	Feb 19	Feb 12	Feb 5
New England	− 1.5	− 2.8	− 1.6
Mid-Atlantic	+ 2.6	+ 1.5	+ 2.4
Central Industrial	+ 8.9	+ 7.3	+ 8.2
West Central	+11.2	+ 8.9	+10.0
Southeast	+10.6	+ 9.4	+ 7.9
South Central	+ 9.8	+ 6.7	+ 9.5
Rocky Mountain	+18.7	+17.0	+21.5
Pacific Coast	+ 6.8	+ 6.8	+ 5.9
Total United States	+ 7.5	+ 6.3	+ 6.8

WASHINGTON COMMENT

WILLIAM B. WHICHARD

THE BITTER PILL that came out of the House fight on New Johnsonville went down hard. But the bad taste that seems to have been left in the mouths of many industry people is largely psychological. It won't last.

Yes, TVA won House approval of its request for money to start the new steam generating plant. And the odds heavily favor a similar result in the Senate. But important as the New Johnsonville issue is—and it is just as vital as it has been billed—there was more to be gained by fighting it and losing than by forfeiting.

The battle really was lost last November. President Truman had made New Johnsonville a campaign issue. Immediately after his election he cleared the way for a new appropriation request to reach Congress early in the session. When the deficiency bill containing TVA funds reached the Capitol, it was accompanied by a Presidential message labeling it urgent business, just to make sure.

A phenomenon of the last election was that it kept an incumbent in the White House but still elected a new President. Until November Mr Truman was the accidental heir to another President's job, administration, and programs. On Jan 20 he became the chief executive in his own right, so to speak.

Politicians, especially members of the 81st Congress, quickly recognized the subtle change. As does virtually every Congress upon the election of a new administration, the 81st came to Washington prepared for a "honeymoon" period. For a few months, at least, the "new" President —with a shiny new "mandate" from the voters—could expect serious consideration from Congress. Certainly his own party, during the "honeymoon," would strive to enact any legislation he termed urgent.

Falling into this category, New Johnsonville enjoyed still another advantage. The initial appropriation asked looked like peanuts to a Congress and a public conditioned to $40,000,000,000 federal budgets. And the issue of federal steam plants, rightly or wrongly, simply did not impress sufficient Congressmen as being of comparable importance with foreign policy, farm price supports, labor legislation, universal military training, or many other items in the President's program.

On some of the latter issues, members of Congress, including a number of Democrats, are expected to clash with the Administration. They are worth fighting about, in the eyes of Congressional opponents of Administration recommendations. After a few such scraps with the White House, Congress can be expected to be less "wild about Harry" and more inclined to disagree with him on power policy matters.

Against such a day the battle put up by opponents of the TVA steam plant accumulated considerable ammunition for future efforts to block expansion of federal power operations. It was an enlightening experience for some new Congressmen and even for some veterans who previously took little interest in public power. And for the first time it was more than a one-industry battle in the sense that representatives of other business interests in impressive numbers stood up to be counted against further public power expansion.

It will take a lot more and better fighting to fend off Interior Department steam plants, valley authorities, and other schemes now in the works. But, as Harry Truman can testify, no one wins without fighting these days.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Insulating oil can advantageously be transported or stored temporarily in a tank trailer of appropriate capacity when the emptied equipment is to be moved and the oil is to be (1) Handled during field tests and operations, (2) hauled fresh from the refinery or (3) hauled stale to the power plant burners.

Hydro buckets are now being pressed out of stainless steel. The splitters are welded on after forming.

Simplicity in line hardware is commendable but some operations are finding that the poorest jobs of installing line connections are being done with the most easily applied devices.

Electric steel melting furnaces are getting larger (now nearing 16 Mva) to meet the shortage of steel; secondary voltages are rising to 350 v to give faster melt-down than the previous 290 v.

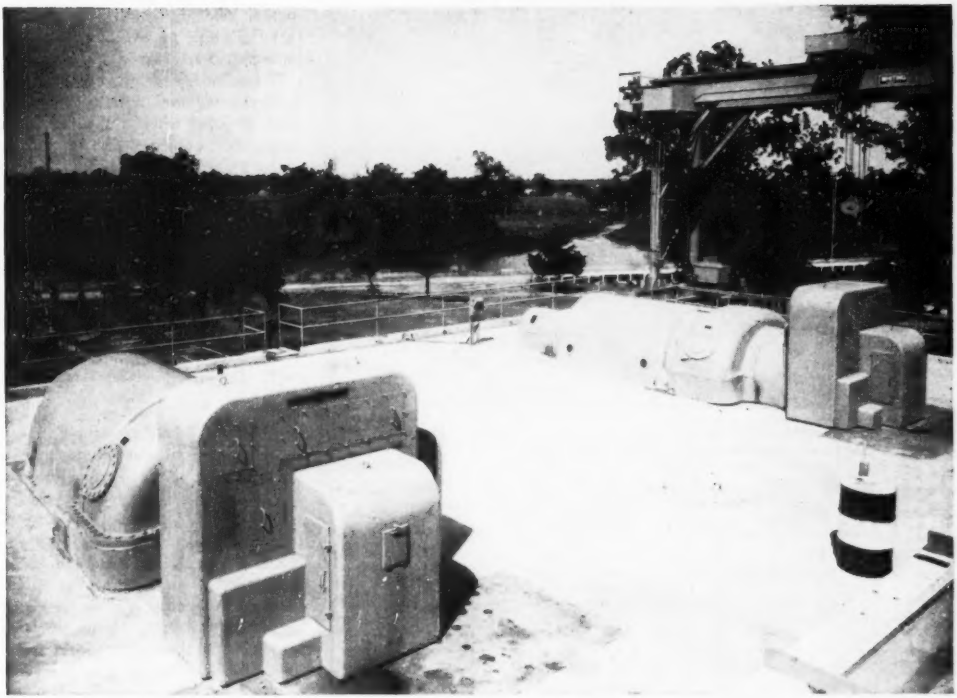
Hoover Dam's Lake Meade is having a million tons (more or less) of silt deposited in it by the Colorado every 24 hrs. A train of gondolas 300 miles long would be required to haul it back.

Corrosion of underground cables and vault equipment (to say nothing of car fenders) is a progressive prospect for many areas if they follow New York's purchase of 20,000 to 30,000 tons of salt to remove ice and snow.

Mobile radio transmitter signal strength can suffer a 15% decrease if battery voltage is 0.2 to 0.3 v below normal.

Suspected winding faults in alternators can hardly be identified and located unless the phase extremities are disconnected from neutral and bus. Otherwise a defective bus insulator may be construed as a deteriorated winding.

Concrete saw equipment is expensive and so is the frequent replacement of diamond-point saws, but some recent experience in sidewalk excavation shows that the costs are quickly recovered.



OUTDOOR TURBINES located on the roof on elevated concrete mat, are completely weatherproofed. Operating room is located below

Outdoor Plant Has Weatherproof Turbines

Problems of weatherproofing turbines and auxiliaries overcome . . . Two 7,500-kw generators driven by turbines operating at 600 psi gage, 825 F . . . Study of all design and site factors saved about $8 per kva

G. A. GAFFERT
Partner, Sargent & Lundy
Chicago

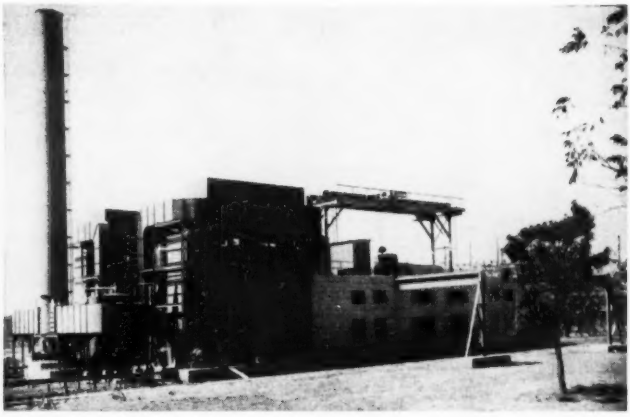
DESIGN of a completely outdoor generating station, including weatherproof turbines, creates problems that are solvable as evidenced by Central Louisiana Electric Co's recently completed Coughlin station. All factors that would affect plant cost, reliability, and system economics were thoroughly reviewed. From this resulted a design that met all requirements and saved an estimated $8 per kva installed.

Careful analysis of past load growth, load distribution, and fuel sources was made. New industries and increased domestic use indicated that a new plant was needed. However, because of the decreasing profit ratio and the increased building costs, it was likewise evident that a thorough engineering analysis should be made of all factors involved so that the most station capacity per dollar invested would result.

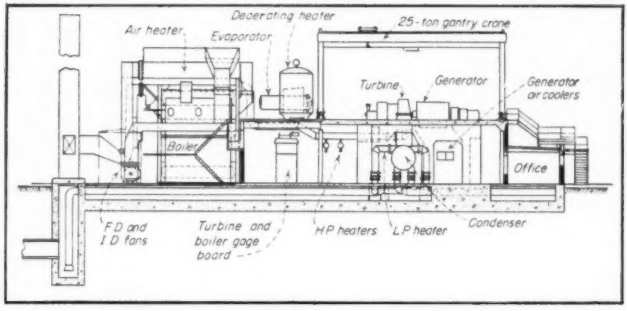
Previously, a 6,050-kw gas engine plant, Rhea Station at Bunkie, had been the main source of power with additional blocks supplied by smaller plants at Pineville, Ville Platte, Le Compte and Cheneyville along with purchases from sister utilities.

Favorable Site

In surveying the area for a suitable site, it was early determined that although Bunkie was closest to the load center, the silting problem in the Red River would necessitate a cooling tower. This would add one item to the station's cost which it was hoped could be eliminated. A subsequent



BOILER AND CRANE details as well as rain proof compartments housing the 440-v auxiliary switchgear are apparent from permanent end of plant



MAJOR COMPONENTS in the station are located for functional relationships and ease of operation and maintenance. Operating room is at ground level between the turbines and the boilers. Boiler feed pumps and control board are located in a row on this floor.

survey located a site with all the desirable features. It was on the Crocodile River at the confluence of the Bayou Cocodrie and the Bayou Beouf just west of St. Landry. Here was sufficient cooling water to permit a development up to 25,000 or 30,000 kw, and natural gas fuel was available from adjacent pipe lines. Also these facilities were adjacent to an existing transmission line. All these factors contributed to cost savings.

System demands made it most economical to initially install two turbine generator units of 7500 kw nameplate capacity each. At a later date, the station capacity may be increased by additional units, each to be operated with a single gas-fired steam generator. Consideration was given to several operating conditions, and it was found economically advisable to use 600 psi gage 825 F operating conditions. The turbines were arranged for steam extraction at three points, the second point connected to a constant pressure deaerating heater. An auxiliary closed feedwater heater was added to make full use of the extraction steam from the second extraction point. The third or high pressure feed water heater raises the feedwater to 350 F at rated load on the turbine.

Climate and Soil Conducive

Consideration was next given to the type of plant. A study of weather conditions indicated 50 in. of rainfall per average year. Freezing weather is infrequent. It was also desirable to keep investment to a minimum consistent with reliable operation. Sufficient experience had been obtained with outdoor boiler operation including fan auxiliaries to indicate that the boiler room housing could be eliminated. Site soil conditions indicated that the whole plant could be placed on a single reinforced concrete mat.

Necessity for a housing over the turbine-generators was next considered. Starting with a totally enclosed room, steel columns with an indoor crane as a base, reduction in cost could be made with outdoor construction, gantry crane and a Quonset house over the turbines. This type of construction was deemed unsatisfactory since the house would have to be taken apart for any turbine overhaul and required additional crane hook clearance.

Turbines Weatherproofed

Next, a fully outdoor plant was considered. Weatherproofing of the turbine-generator was discussed with the engineers of the General Electric Co and it was agreed to develop a weatherproof design. This was accomplished in the following manner. Starting with the electrical end of the machine, the exciter housing which fits onto its own sole plate was connected to this sole plate with cap screws. Also the vertical joint at the generator was sealed with the plate and gaskets. The generator sole plates on each side made an excellent seal against the stator supporting feet. The space between the exhaust end of the turbine and inboard end of the generator was sealed with a lagging strip fitted to a built up angle on the turbine exhaust casting on one side and another angle on the generator lagging.

A curb 6-in. high was constructed at the floor line at all points where the turbine outline was adjacent to concrete and the turbine lagging extended down over the curb to within one inch of the floor to form a weather seal. Complete lagging was formed over the camshaft and valve gear and extended over the front pedestal and down to the floor line. The top of the oil tank on the standard 7500-kw turbine-generator is set flush with the operating floor. The lagging was sealed over a curb angle set on this oil tank.

Since considerable heat would be released at the steam end a ventilating fan mounted on the front pedestal, drawing air from the operating space below and discharging through slots in the lagging, was installed. Finally, to prevent rain or wind from blowing

under the seals on the generator or exciter end, a small blower was installed to place this space under pressure. It was also decided that the turbine generator foundation should be made integral with the floor or deck around the machine. Thus the whole turbine and the deck was made water tight. Inspection doors with suitable gaskets are provided at the steam end of the machine for observation and access to camshaft, cams and governor gears. These details are readily discernible in the accompanying deck floor illustration.

A 25-ton gantry crane services the turbine generators. It is arranged to travel out over a track to pick up turbine parts from a rail car and place them on the deck. The common deaerating heater is located on the deck between the turbines and the boilers as is also the evaporator. Both are insulated and covered with Insulkote to provide an all weather coating. Auxiliary 440-v switchgear housed in rain proof compartments is located on the deck along with the unit oil insulated auxiliary transformers.

Controls Centralized

The space beneath the deck between the turbines and the boilers is used as an operating room. Boiler feed pumps and the station control board are located in a row on this floor. The front of each boiler also faces this space and all of the gas burners, regulators and valves are accessible therefrom.

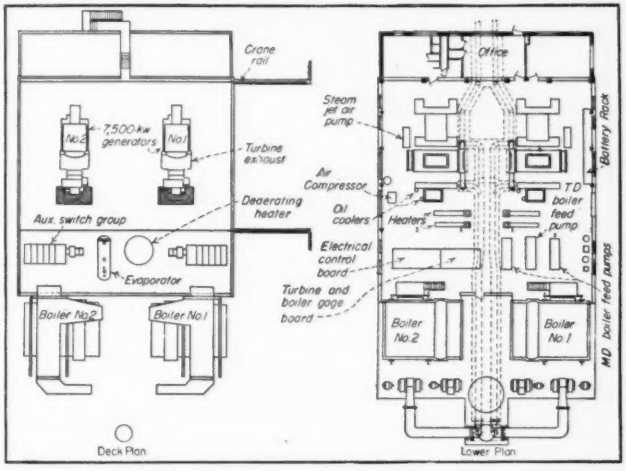
Operation with a minimum staff suggested a common turbine, generator, feeder circuit, and boiler board. The complete board is some 25 ft long, double faced with a 6-ft walk spaced between faces. The turbine instruments are on one face, opposite to the boiler face while the generator and feeder controls are opposite to the electrical relays. Since all normal operation is in connection with generator loading and boiler operation, these faces are placed on the same side. It is contemplated that this one board will be continuous and extended for the next additions. Thus there will be two boiler control panels on one end, four generator panels and feed circuit panels in the center and two more boiler control panels on the opposite end.

Because of an outdoor turbine installation, all important turbine operating instruments were located on the turbine gauge board below the turbine deck. Each bearing oil temperature is indicated on a dial thermometer. Governor and bearing oil pressure is similarly indicated. In addition, all the usual steam pressure, extraction pressure, exhaust pressure gauges and cycle feedwater temperature recorders are on this board.

Power is generated at 6900 v and carried by underground cable to 9,000 kva, three-phase transformers stepping up to 34,500 v in the adjacent outdoor substation. At present, four feeders leave the plant at this voltage to serve the system. The substation utilizes a main and transfer bus with 34.5-kv, 500,000-kva circuit breakers. There are no circuit breakers at generator voltages. Unit auxiliary transformers are tapped off each generator lead to supply auxiliaries on that unit. A reserve supply is obtained from a transformer stepping down from the 34,500-v bus. The reserve motor-driven exciter, 125-v storage battery, generator field-switch panels and neutral grounding equipment consisting of resistors in distribution transformer secondaries are located on the turbine room basement floor. Flood lighting is used for illumination of the outdoor turbine generators and boilers.

The present two-unit plant is operated by three men on each shift, a total of 15 men for the complete operating staff.

ADDITIONAL UNITS can be installed by knocking out visible wall and extending toward foreground. Power is carried underground to substation and stepped up from 6.9 to 34.5 kv



FOUNDATION of turbine generator is integral with deck floor around the machine, providing watertight construction. Small blower keeps weather seals under pressure

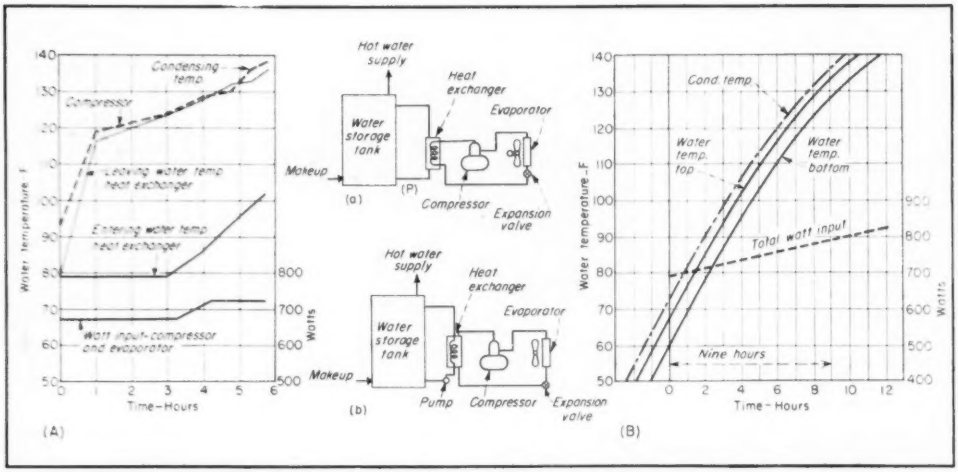


FIG 1—TESTS with 86-gal tank and ½-hp compressor with and without circulating pump. (A) Without pump, water at top of tank after 5¾ hr was 136 F, bottom 102 F, average 119 F. (B) With pump, water at top after 9 hr was 33.7 F and bottom 129.2 F

Heat-Pump Water-Heater Promises Practicability

Two years of testing with experimental 86-gal tank and ½-hp compressor shows approach to coefficients of performance at competitive levels

PHILIP SPORN and E. R. AMBROSE
American Gas & Electric Service Corp
New York, N. Y.

VERY LITTLE THOUGHT has been given to the design and manufacture of a heat pump water heater for the heating of the domestic water supply. It is believed by many that this device has equal if not greater possibilities than the heat pump air conditioner, at least for the immediate future. The heat pump water heater is readily adaptable to a self-contained package device which can be manufactured by quantity production methods and techniques.

The cooling effect produced by the evaporator can be used to reduce the temperature in a space, thereby obtaining double duty of cooling the space while simultaneously heating the domestic water supply. Also, a heat pump water heater with a coefficient of performance of 3.5 to 4 can be competitive in operational costs with the more common fuels of coal, oil, and gas in many sections of the country. In addition, it possesses all the advantages cited for a heat pump unit, such as no products of combustion, no chimney, no odors, no soot, no possibilities of explosion, plus the ability to automatically furnish heating as well as cooling.

The most serious handicap facing this device, when compared with the more conventional hot water heating units, is the first cost. If the unit can be designed and assembled for quantity production so that the manufacturing cost will be a minimum and at the same time effectively use the cooling effect available, then the first cost will no longer be an insurmountable obstacle.

To receive wide public acceptance, a substantial amount of time and effort must be made in research development and design of the unit in order to properly correlate the various requirements and produce a device having five basic qualities:

1. High reliability.
2. Economical performance. The unit must be highly efficient and subject to inherently low maintenance cost.
3. Reasonable first cost.
4. Compactness.
5. Neat appearance.

The American Gas and Electric Co and subsidiary companies, consisting of Appalachian Electric Power Co, Indiana & Michigan Electric Co, Kentucky and West Virginia Power Co, Inc. Kingsport Utilities, Inc., The Ohio Power Co, Wheeling Electric Co and Citizen Heat Light and Power

Co, believe that the heat pump water heater holds sufficient potentialities to warrant an active program of research and development. Toward this end an extensive investigation has been made to determine the probable design and operational difficulties. A number of performance tests were conducted on three different developmental designs of heat pump water heaters to obtain actual performance data:

1. The first design tested consisted of a ½-hp 680 rpm, open type compressor, forced air evaporator, and a water-refrigerant heat exchanger, all located externally to an 86-gal water tank. In some of the tests, the thermal head due to the entering and leaving temperature differentials was employed to circulate the water between the heat exchanger and the tank. In other tests a small pump was used to provide forced circulation between the heat exchanger and the water storage tank.

2. In the second design the condenser or water to refrigerant heat exchanger was located directly in the bottom section of the water tank. The compressor and evaporator were located externally to the water tank, similar to that employed for design No. 1.

3. In the third design a hermetically sealed, Freon F-12, ½-hp compressor was mounted directly in the top portion on the water tank and the condenser in the bottom portion. The evaporator was located externally to the water tank in this instance.

It is the hope of the authors that publication of these test results and conclusions, condensed by necessity from a complete engineering report because of space limitations, will serve to stimulate additional research and development by all interested parties so that a satisfactory and acceptable heat pump water heater will be available in the future.

Of the three designs tested the hermetically sealed unit mounted directly in the water storage tank offers the most promising possibilities for obtaining a practical heat pump water heater. With this arrangement, it was possible to obtain an average heating rate of 7700 to 8020 Btu/hr using an initial water temperature of 60 F. In the drawoff tests the final water temperature in the top compartment was between 142 and 155 F, and the coefficient of performance between 2.86 and 3.46, based on energy input to the compressor motor only, and 2.48 and 2.93 based on energy input to the compressor motor and all auxiliaries.

Equipment and Performance Tests

No. 1 Test Series—The first domestic heat pump water heater was assembled and tested during July 1946. In this series of tests the 39 F average temperature differential between the water entering and leaving the heat exchanger indicated that forced circulation is required. The average entering air temperature to the evaporator was 77 F, and the average air flow over the evaporator was 510 cfm (Fig 1a).

The average water heating rate was 4630 Btu/hr, and the average coefficient of performance (including energy input to the compressor motor and all auxiliaries) during a typical cycle was 2.1.

No. 2 Test Series—A small circulating pump (Fig 1b) was installed on the intake side of the exchanger. The average entering air temperature to the evaporator was 78 F, and the average air flow over the evaporator was 510 cfm.

In this test series the temperature difference between the water entering and leaving the heat exchanger is 5.7 F which is a big improvement over the 39 F obtained in No. 1 Test Series. The water heating rate was 5450 Btu/hr, and the average coefficient of performance during a typical cycle (including energy input to the compressor motor and all auxiliaries required by the water circulating pump) was 2.2.

No. 3 Test Series—In this series of tests the refrigerant-water heat exchanger (condenser) was located directly in the water tank in order to try to improve the coefficient of performance. The schematic equipment diagram and the representative performance are given by Fig 2a.

Water temperature variation, except for the bottom 10 in. was seldom

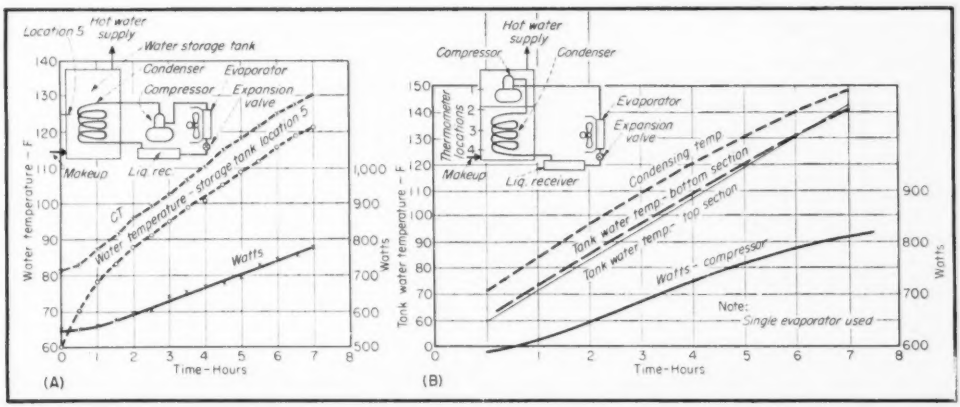


FIG 2—TESTS with (A) condenser and (B) condenser and compressor in tank. (A) Condenser comprised 65 ft of ⅝-in. OD tubes in double coil. After 7 hr average tank temperature was 121 F. (B) Hermetically sealed compressor immersed in upper section of abbreviated tank (capacity 75 gal). Holes in support plate allow water circulation. After 7 hr the top was 142 F, bottom 140 F

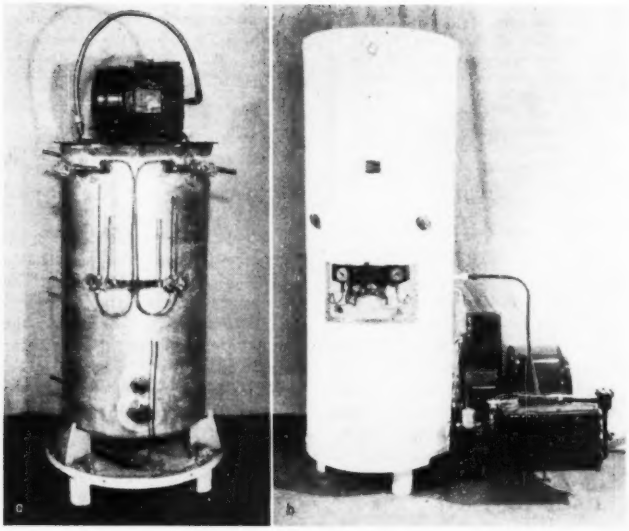


FIG 3—TESTS modified to house immersed compressor. (a) With casing and top of water tank removed. (b) Heat-pump water-heater completely assembled

more than 3 F. The air flow over the evaporator averaged 435 cfm. The average air temperatures entering the evaporator was 65 F. The evaporator fan motor and refrigerant liquid solenoid valve require 80 w. The water heating rate was 6100 Btu/hr, and the average coefficient of performance during a typical cycle was 2.68 using energy input to the compressor motor only, and 2.40 using compressor input to the compressor motor and all auxiliaries.

No. 4A AND 4B TEST SERIES—In this series of tests the compressor as well as the condenser was located directly in the water tank (Fig 3). The schematic equipment diagram and the representative performance for No. 4A Test Series are given by Fig 2b. The condenser consists of approximately 100 ft of ⅝-in. O. D. copper tubing in the form of a coil supported by ¼-in. rods welded to the coil loop.

Fig 3a is a photograph of the water heater with the casing, insulation, and the top of the water tank removed showing the hermetically sealed compressor. The steel plate contains two 1-inch dia. holes to permit water flow from the bottom to the top section. To make the conduit for power supply water-tight, the terminal box and the loop of ⅝-in. O. D. tubing was filled with a compound having a high melting point. The tubing connections on the bottom section of the tank are refrigerant pressure connections. The net capacity of the tank was 75 gal. Fig 3b shows the water heater fully assembled.

The water heating rate was 8020 Btu/hr, and the average coefficient of performance during a representative cycle was 3.46 for the compressor only and 2.93 for the compressor plus auxiliaries.

The air flow over the evaporator averaged 580 cfm. The air temperature entering the evaporator averaged 72 F. The evaporator air entering-leaving temperature differential was 10 to 13 F, and the saturated refrigerant suction temperature was 41 to 48.5 F. The evaporator fan motor and solenoid valve required 125 w.

Fig 4a gives the performance of the heat pump water heater after a second evaporator coil was added (No. 4B Test Series); otherwise, the equipment is the same as used to obtain performance shown by Fig 2b. The water heating rate was 7700 Btu/hr, and the average coefficient of performance as 2.95 for the compressor only, and 2.55 for the compressor plus auxiliaries.

The air flow over the evaporator averaged 580 cfm. The air temperature entering the evaporator averaged 69 F. The evaporator air entering-leaving temperature differential was 10 F, and the saturated refrigerant

TABLE I—Summary of Tests

Series Test Number	Reference Figure	Hr Duration of Test	Final Water Temperature F: Top Third	Middle Third	Bottom Third	Condensing Temperature F: Initial	Final	Average	Suction Temperature F: Initial	Final	Average	Watts Input Compressor Motor only: Initial	Final	Average	Coefficient of Performance Cop.: Average Heating Rate Btu/Hr	Compressor Motor Only	Compressor Motor and All Auxiliaries
1	1a	5.75	136	119	102	93	136	123.5	38	38	38	670	720	690	4630	....	2.1
2	1b	9.0	133.7	131.5	129.2	72	136	102	42	48	45	690	790	740	5450	....	2.2
3	2a	7.0	122	121	108	81	130	106	31	42	37	550	780	665	6100	2.68	2.4
4a	2b	7.0	142	140	132	70.5	148	110	41	48.5	45	590	810	701.4	8020	3.46	2.93
4b	5	5.0	148	145	80	91	149	128	43	52	50	620	825	750	7700	2.95	2.55
5a	5	1.16	146	139	77	121	144	135	51	53	51.8	695	790	750	7600	2.86	2.48
5b	5	1.50	152	140.5	74	100	146	127	50	53	51.6	590	800	714	7720	3.19	2.71
5c	5	2.50	155	140	86	87	146	120.5	50	55	52.7	550	830	708	8020	3.31	2.82

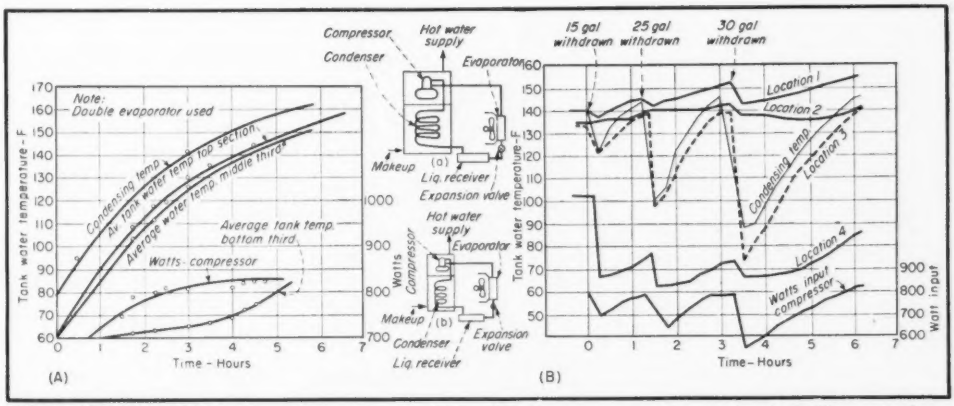


FIG 4—PERFORMANCE (A) with second evaporator coil and (B) with three drawoffs. (A) After 5 hr top 148 F, middle 145 F, bottom 80 F (due to excessive refrigerant charge). (B) Thermometer locations: 1, middle of top section; 2, 3, 4 equally spaced in bottom

suction temperature was between 49 and 52 F. The evaporator fan motor and solenoid valve required an estimated 125 w.

No. 5 TEST SERIES—The entire tank of water was heated in Test Series No. 1 to 4 starting with a cold tank of water at a temperature of approximately 60 F. These tests are valuable in determinating the heating rate and the relative temperature of the water and refrigerant, but they do not simulate the normal cycle of operation experienced in an actual installation.

To more nearly duplicate the normal cycle encountered under actual field conditions, three drawoff tests were made. Test 5(a) consisted of drawing off 15 gal of heated water from the top of the tank and then heating the tank water to a predetermined temperature. The makeup water to the bottom of the tank was 60 F. Test 5 (b) consisted of drawing off 25 gal of heated water from the top of the tank and again heating the tank water to a predetermined temperature. Test 5 (c) consisted of drawing off 30 gal from the top of the tank and heating the tank water to a predetermined temperature.

The variation in the tank water temperature, the refrigerant condensing temperature, and the compressor watt input during these three drawoff tests are given by Fig 4b.

The same equipment used during Test Series No. 4B was used for these tests. The air flow over the evaporator averaged 580 cfm. The air temperature entering the evaporator averaged 69 F. The evaporator air entering-leaving temperature differential was 8 to 9 F, and the saturated refrigerant suction temperature was 51 to 55 F. The evaporator fan motor and solenoid valve required 125 w.

In Test 5(c) the average final water temperature in the top section was 146 F, and the average heating rate was 7600 Btu/hr. The average coefficient of performance was 2.86 for the compressor only, and 2.48 for the compressor and all auxiliaries.

In Test 5 (b) the average final water temperature in the top section was 152 F, and the average heating rate was 7720 Btu/hr. The average coefficient of performance was 3.19 for the compressor only, and 2.71 for the compressor and all auxiliaries.

In Test 5(c) the average final water temperature in the top section was 155 F, and the average heating rate was 8020 Btu/hr. The average coefficient of performance was 3.31 for the compressor only, and 2.82 for the compressor and all auxiliaries.

Discussion of Test Results

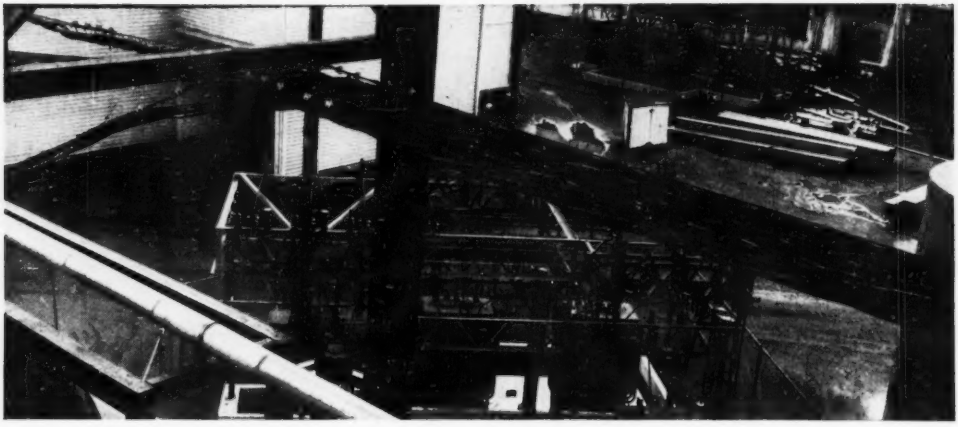
Table I gives the summary results of the five test series. From this table and the performance curves (Fig 1, 2, 4), it can be seen that the coefficient of performance is materially affected by the initial tank or makeup water temperature, the final tank water temperature, the temperature of air entering the evaporator (ambient or room temperature), and the energy consumption of the auxiliary equipment. The initial and final tank water temperatures and the entering air evaporator temperature in turn determine the condensing temperature and the suction temperature. The higher the suction temperature and the lower the condensing temperature, the higher the coefficient of performance.

Test Series No. 2 indicates that it is possible to heat 86 gal of 60 F water to approximately 130 F in nine hours using a ½-hp conventional open type refrigerating compressor with all the equipment located extenally to the storage tank. The average coefficient of performance which can be expected with such an arrangement will be in the neighborhood of 2.2.

As illustrated by Test Series No. 3, a slight improvement in performance is obtained by locating the condenser inside the water tank. In this arrangement it was possible to obtain a water heating rate of 6100 Btu/hr with a coefficient of performance of 2.4 as compared with 5450 Btu/hr with a coefficient of performance of 2.2 for Test Series No. 2.

Test Series No. 4 and 5 indicate that an improvement in performance is realized by locating both the compressor and the condenser in the water tank. With this arrangement it was possible to obtain an average heating rate between 7700 and 8020 Btu/hr when starting with a tank of 60 F water, resulting in an average coefficient of performance of 2.55 to 2.93. In this arrangement the high temperature losses from the compressor and motor shell are utilized

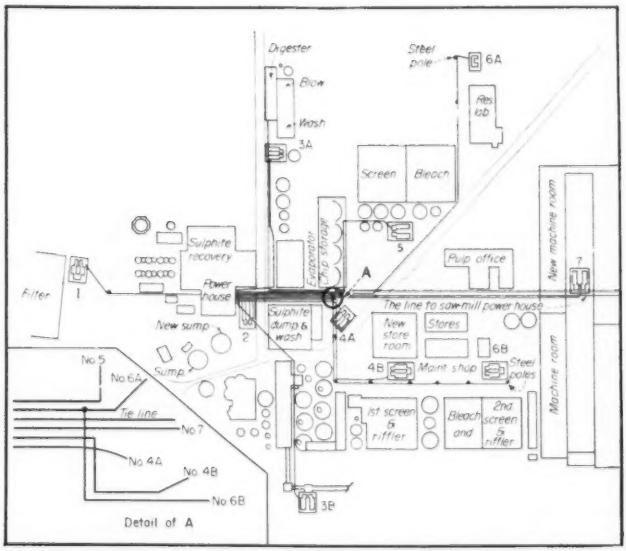
(*Continued on page* 151)



ATTACHMENT OF CABLE MESSENGER to existing structures without need for ground clearance facilitated layout and construction. The two load center substations are typical of construction of all ten in the plant, with ratings up to 4,700 kva

Aerial Cable Fine for Plant Distribution

Pre-assembled self-supporting 15-kv aerial cable used throughout . . . Adaptability and reliability in close quarters achieved



AERIAL CABLE DISTRIBUTION at 13.8 kv serves this new pulp plant of Weyerhaeuser Timber Co at Longview, Wash. Power is supplied to ten load center substations on a radial system. Although a standby connection to the local utility is maintained, nearly all process steam and electrical energy for the plant is generated by burning liquid waste products

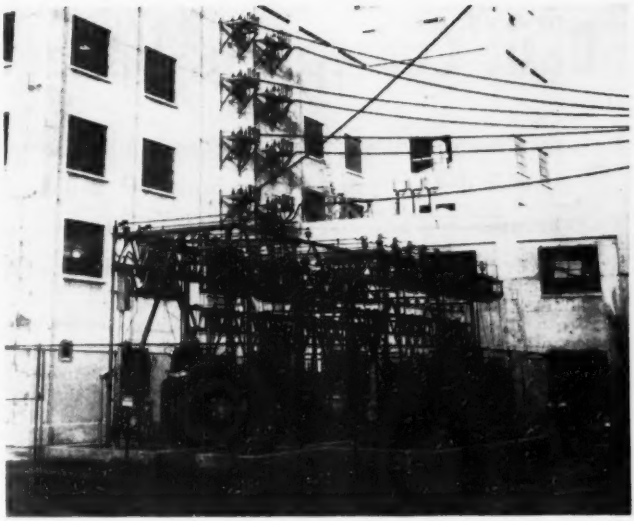
RELIABILITY, economy and simplicity dictated use of a 13.8-kv distribution system of self-supporting aerial cable in the new sulphite pulp plant of Weyerhaeuser Timber Co at Longview, Wash. Reliability is paramount in this plant, since expensive raw materials may be lost and machinery damaged by an emergency shutdown. Shielded cable eliminates severe problems of insulator contamination and maintenance necessary for equal reliability on open wire construction.

Cost of construction and operation of the aerial system is substantially less than other methods investigated. Local ground conditions and many high structures in the plant accentuated the advantage.

Installation of the system was simplified by use of existing structures to support the cable. It was fastened on conveyor structures, sides of buildings and carried over rooftops with equal facility. These same structures would have made circuitous routing of 13.8-kv open wire difficult or impossible.

Distribution in the plant plus a 13.8-kv tie line required over 10,000 ft of pre-assembled shielded aerial self-supporting cable. This is the first large industrial application of this cable originally developed by Okonite for utility use. The 4,700 ft of 15-kv, 3-conductor No. 2/0 cable used for primary distribution is cabled and bound with copper tape to a $\frac{1}{2}$-in. extra high strength copperweld messenger. The 3,000-ft tie line to Weyerhaeuser's adjoining sawmill power plant is the same, except 300 mcm and a $\frac{9}{16}$-in messenger. Transformer secondaries use 1,600 ft of 3-conductor, 5-kv No. 1/0 and 1,200 ft of 2-conductor, 600-volt No. 1/0.

Installation of the pre-assembled cable under existing conditions proved to be simpler and faster than overhead construction. It was strung from reels directly over large pulleys in spans up to 60 ft. The supporting messenger was fastened to steel, wood or concrete structures. With this flexibility, circuits could pass through restricted spaces between buildings, through and under steel structures and near ladders or platforms where open wire could not be placed.



AERIAL CABLES START on the outside of the powerhouse, where lightning arrestors are located. Lead-covered feeder cables are terminated in potheads on the outside of the building for connection to aerial cables at this point

Alternatives Were Uneconomical

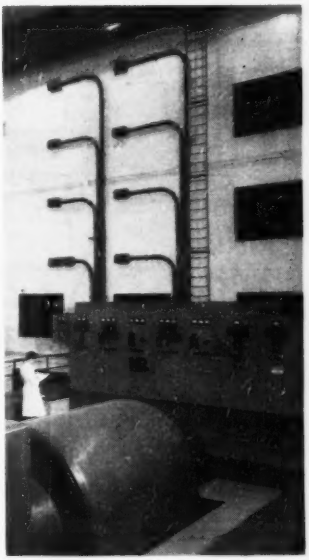
The plant's many high buildings, conveyor systems and pipes would have made extremely high towers mandatory for open wire construction, at a substantially higher overall cost. Location of the plant on reclaimed marshland below river level made direct earth burial or ducts and manholes impractical because of moisture and settling. Western Electrical Construction Co. the electrical contractor who planned and made the installation, estimated that any of these alternatives would have cost at least 25 to 50% more than the aerial cable.

Radial distribution was chosen for economy and performance. The combined batch and continuous process of the plant requires that certain operations be completed before stopping the entire process, even in an emergency. Radial distribution provides maximum independence for these separate plant operations. Any circuit can be killed for an emergency or maintenance without affecting the remaining circuits.

Distribution at 13.8 kv provides excellent voltage regulation throughout the plant. Over-all voltage level is controlled by generator voltage regulators. Preponderance of synchronous motors for nearly all large continuous drives provides ample power factor correction. Thus neither voltage correction nor static capacitors are required, as is often the case in a large industrial plant.

Load center substations of 200 to 4,700-kva capacity scattered through the plant are supplied by 13.8-kv circuits up to 750 ft long. They supply power at 2,300 v for all motors over 100 hp, 550 v for other load. Standard interchangeable three-phase transformers rated 500 or 750 kva were used throughout to make up the required capacities. Ample margin in all stations provides for shifting a transformer from one to another in case of failure. Added expense of carrying spare units is thus unnecessary. Separate lighting transformers stepping down directly from 13.8 kv to 115/230 v are also located at each substation.

Two 6,250-kva, 3,600-rpm turbogenerators operate at 600 psi to supply power at 13.8 kv and process steam at 135 psi and 35 psi. Lead-covered feeder cables are carried in conduit up the inside wall of the powerhouse as shown. Standard potheads outside the wall connect the lead-covered to the aerial cable. For maximum reliability, 23-kv potheads are used on the 13.8-kv circuits throughout the plant. Lightning arrestors were also installed at this point and at the other end of each run.



OUTGOING FEEDERS on inside wall of powerhouse are lead-covered cable in conduit

Basic Concepts of Voltage Regulation

Maximum voltage spread depends upon service requirements . . . Feeder design is based on permissible voltage drop during peak load between first and last transformers . . . The requirement of single-phase, three-phase, and bus regulation depends upon operating conditions

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Central Station Engineer
General Electric Co, Schenectady, N. Y.

THE THREE common methods for regulating voltage are: (1) Bus regulation; (2) individual feeder regulation; and (3) supplementary regulation, either in the feeder or branch, in combination with (1) or (2). The basic distinctions between these methods are shown in Fig 1. The voltage of 3-phase feeders, either individual or branch, can be controlled with 3-phase regulators or banks of single-phase regulators.

Although the same level of voltage cannot exist throughout the entire system at all times, the voltage spread can be held within satisfactory limits. In general, maximum voltage spread is limited by the quality of service expected or required by the consumers.

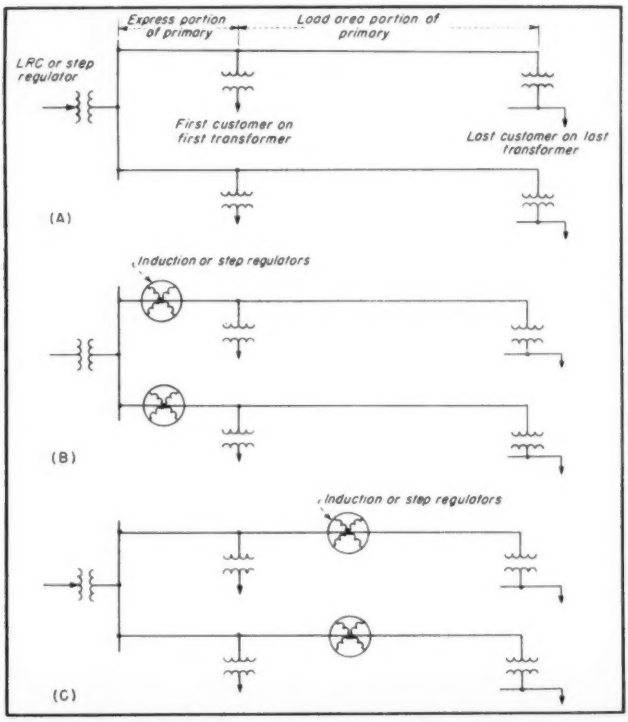


FIG 1—BASIC METHODS for regulating voltage: (A) Bus-regulation; (B) individual feeder regulation; and (C) supplementary regulation. Each has a useful field of application

As a rule, the first customer connected to the transformer nearest the feeder substation, receives the highest voltage. This usually occurs when (1) the feeder is carrying peak load and (2) the first customer's load is sufficiently light so that the voltage drop through the transformer, secondary circuit, and service is negligible. At the same time, the last customer connected to the transformer farthest away from the feeder substation receives the lowest voltage. Therefore, the maximum voltage spread between the first and last customer is most likely to occur during peak load on the feeder. The spread will be (1) the voltage drop between the first and last transformer plus (2) the voltage drop in the last transformer, the associated secondary circuit and service.

Design Limitations of Voltage Spread

In designing urban feeders, it is common practice to keep the voltage spread between first and last customer within 10%. Some State Commission rulings require less than this. The voltage profile of a typical feeder during peak load with the allocated voltage drops is shown in Fig 2. The transformer, secondary circuit and service voltage drops of 3, 3 and 1%, respectively, are average values. Therefore, the permissible drop in the primary between first and last transformer is 3%, for a total maximum spread of 10% between the first and last customer.

The way distribution transformers are loaded may allow a larger permissible voltage drop for the primary. For example, if during the heavy load periods of the feeder the first transformer always carries sufficient load to cause a drop, say 2%, the per-

missible primary voltage drop could be 5% instead of 3%. Or it could be 4% in the primary with 4% in the last transformer. In light density areas, such as 10 to 15 kva per 1,000 ft, the short secondary required to keep flicker voltage under 3 v causes less than 3% drop for normal load. This voltage saved in the secondary can be added to the permissible primary voltage drop, as can be seen from the diagrams.

Many 3-phase feeders with line-to-line voltage of 4,160 v have predominantly single-phase loads. In such circuits, unbalanced loads usually occur which cause unbalanced voltage drops in the feeder. Before discussing the problems of unbalanced voltages, the general principles of regulation are expained first for the simple single-phase circuit.

Single-Phase Regulation

To provide all customers on a single-phase circuit with a voltage spread of 10%, during peak load (1) the voltage spread is limited to 10% and (2) the voltage at the first transformer is held constant at the upper voltage limit. Voltage variation in the substation output during any specific load simply raises or lowers the system voltage. It does not change the distribution of the voltage drops within the load area portion.

Distribution of the drops is determined by the circuit design. For example, Fig 3 shows a single-phase feeder with a single-phase regulator. Although the regulator is located at the station, it can hold automatically a specific voltage at any desired point in the circuit by its line drop compensator. In Fig 3 (A), the voltage regulating relay of the regulator is set to hold the nominal 120 v and the line drop compensator set to maintain the primary voltage of the first transformer constant at 120 v. Thus, under light load condition the last customer receives 117 v but under full-load condition the last customer's voltage drops down to 108 v, which is too low. Assume the desired voltage limits are 126 and 114 v, which is equivalent to a 10% spread. The voltage regulating relay on the regulator can be reset to 126 v so that primary voltage of the first transformer is held at 126 v instead of 120 v. Then under full-load condition, the last customer's voltage is

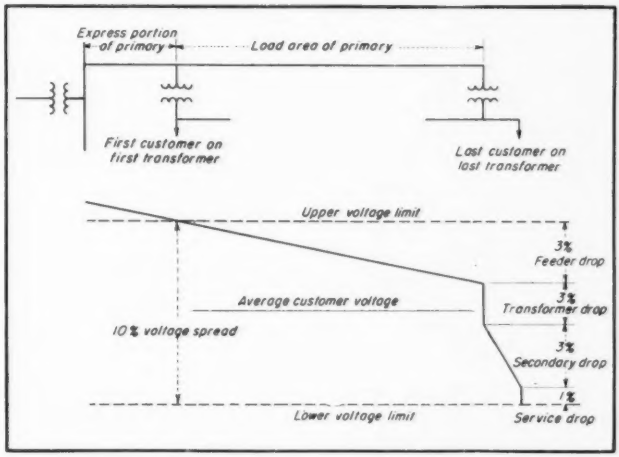


FIG 2—PROFILE of allocated voltage drops showing upper, average and lower limits

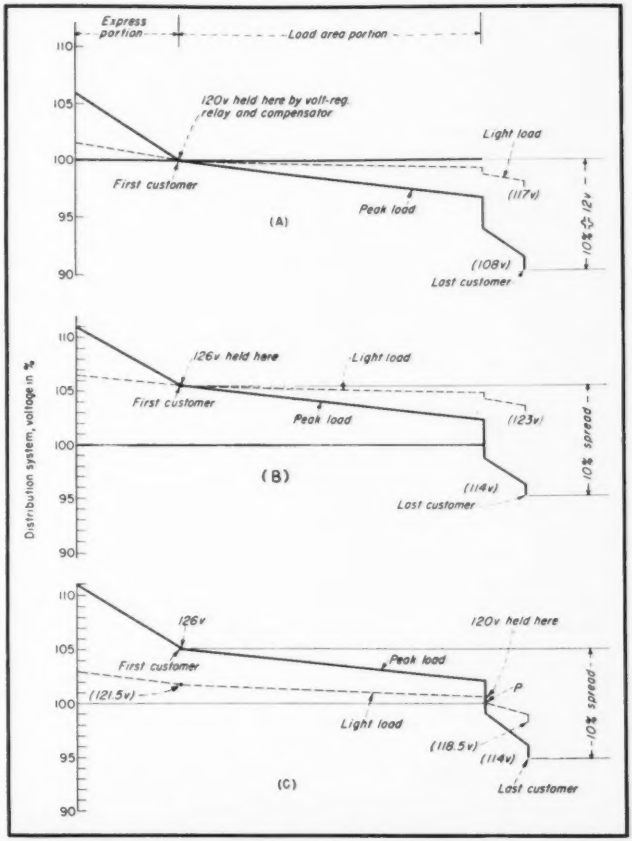


FIG 3—SINGLE PHASE FEEDER with regulator set to hold: (A) at first customer 120 v; (B) same, but 126 v; and (C) 120 v at Point P. Value is obtained by linedrop compensator

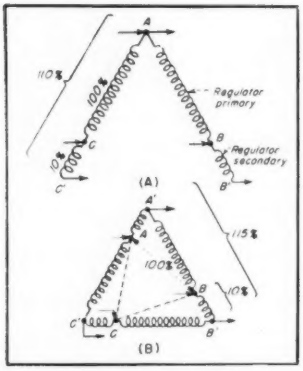


FIG 4—SINGLE PHASE 10% regulators give: (A) 110% connected open delta; and (B) 115% on closed delta

114 v and all customers on the feeder receive a voltage within the desired limits. Under light load condition, the last customer's voltage is 123 v, and the average voltage along the feeder is 124.5 v. This is permissible, but it would be better if the average were 120 v during light load as well as full load. The regulator capabilities can be used to better advantage by adjusting the voltage regulating relay to 120 v and setting the line drop compensator so that the regulator holds voltage constant at 120 v at a point in the circuit corresponding to *P* in Fig 3 (C). Then under full-load condition the primary voltage at the first transformer is 126 v. Under light load condition the voltage at the first transformer primary is 121.5 v and the voltage the last customer receives is 118.5 v.

Open-Delta Regulation

The same method of regulating a single-phase circuit with a regulator can be used to regulate a 3-phase circuit with two regulators, as shown in Fig 4(A). Each regulator responds to the exact needs of the phase in which it is connected. The third phase voltage will be approximately correct. If the third phase voltage is not held sufficiently close because of unbalanced loads and/or low power factors, a third regulator can be used as shown in Fig 4 (B).

Three single-phase regulators can be connected either into a delta bank, as shown in Fig 4 (B), or into a wye bank to regulate a 3-phase circuit. Standard plus or minus 10% regulators connected into delta bank provide plus or minus 15% regulation in the 3-phase circuit. When plus or minus 10% regulators are connected into a wye bank, the 3-phase circuit is regulated a like amount. However, for the same kva load, the required kva capacity of the regulators connected into a delta bank is approximately 15% greater than for regulators connected into a wye bank. (See *Voltage Regulation for Three-Phase Circuits* in the December 1946 issue of *General Electric Review*.)

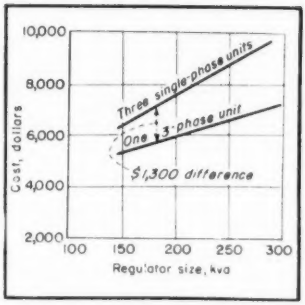


FIG 5—A THREE-PHASE REGULATOR costs less than three single-phase units

A 3-phase circuit can be regulated by one 3-phase regulator or a bank

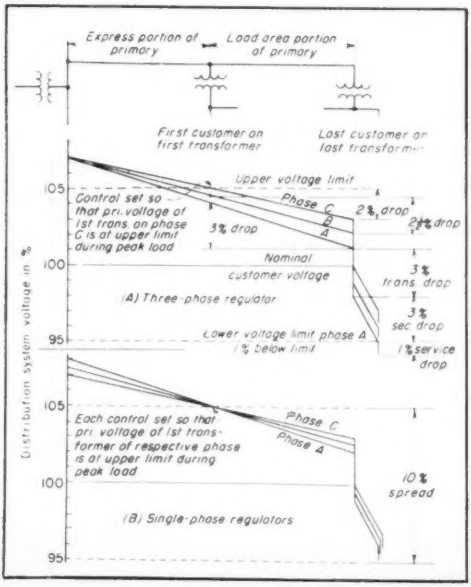

Express portion of primary
Load area portion of primary
First customer on first transformer
Last customer on last transformer
Upper voltage limit
Control set so that pri. voltage of 1st trans. on phase C is at upper limit during peak load
Phase C
B
A
2% drop
2½% drop
3% drop
Nominal customer voltage
3% trans. drop
3% sec. drop
1% service drop
(A) Three-phase regulator
Lower voltage limit phase A 1% below limit
Each control set so that pri. voltage of 1st transformer of respective phase is at upper limit during peak load
10% spread
(B) Single-phase regulators
Distribution system voltage in %
105
100
95

FIG 6—VOLTAGE-DROP PROFILES of unbalanced feeder: (A) One three-phase regulator, (B) bank of three single-phase units

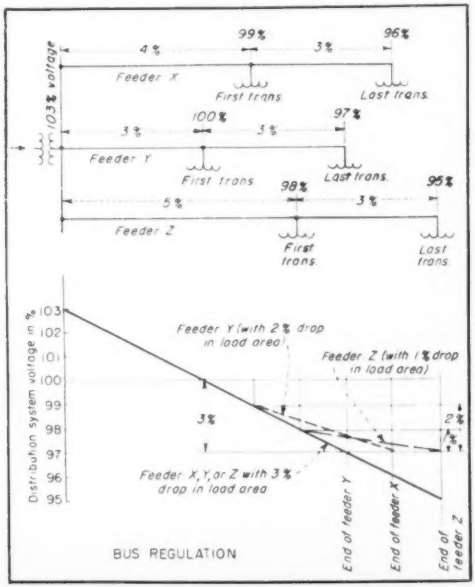


FIG 7—BUS REGULATION for three feeders with unequal voltage drops. Relationships for the different values are shown

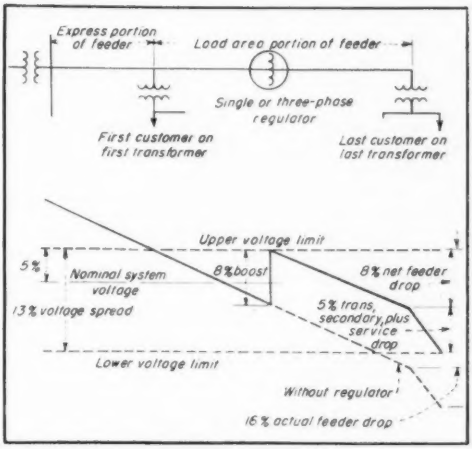


FIG 8—**BAND WIDTH** of the regulator is included in spread

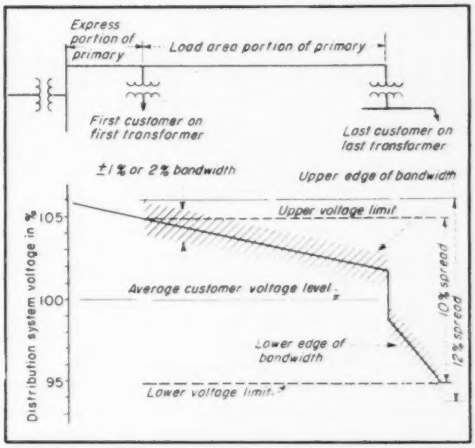


FIG 9—**VOLTAGE PROFILE** of rural feeder showing 13% spread

of two or three single-phase units. A single 3-phase regulator costs less than a bank of regulators connected open-delta or three single-phase, as shown in Fig 5. Assume a particular 4.16-kv feeder has a peak load of 1,800 kva; then the required rating of a plus or minus 10% 3-phase regulator for this feeder is 180 kva. A bank of three single phase 60-kva regulators will cost, not including installation, approximately $1,300 more than a 3-phase regulator. The extra cost may be justified when feeders are supplying unbalanced loads or the supply voltage is unbalanced. For some circuits that do not transpose conductors, single-phase regulation can be justified even if the load and supply voltage both are perfectly balanced.

Loads on distribution feeders, in domestic areas, are largely single-phase and variations of such loads throughout the day cause unavoidable unbalanced currents resulting in unequal voltage drop between phases. If unbalances occur in the load area the same degree of unbalanced current will exist in the express portion of the feeder. As the loads become larger, the effects of unbalance are more pronounced. If the feeder is regulated by a 3-phase regulator, it may be necessary to reduce the voltage drop between the first and last transformer to provide voltage to all customers within the allowable limits. This is shown by the voltage drop profile of the individual phases of a 3-phase feeder in Fig. 6. For instance, unbalanced currents might cause the following voltage drops:

	Percent drop	
Phase	*Load area portion*	*Express portion*
A	3.0	3.0
B	2.5	2.5
C	2.0	2.0

Voltage profiles of all three phases, when regulated by a 3-phase regulator with control set on phase C, are shown in Fig 6(A). A 3-phase regulating device holds voltage as required by one phase only, so the other two phases must follow in accordance. As a result, the voltage at the last transformer of phase *A* is 1% below the lower limit. If the control were set to hold the voltage of the first transformer on phase *A* at the upper voltage limit, then the voltage at the first transformer of phase *B* and *C* would be ½% and 1%, respectively, above the upper voltage limit.

To maintain voltage throughout the entire load area within the limits shown in Fig 6(A), the control should be set on phase *C* and the load area portion of phase *A* redesigned to reduce the voltage drop 1%. But by regulating the feeder with three single-phase regulators the voltages in the load area can be held within the limits without redesigning, as shown in Fig 6(B). Therefore, a bank of three single-phase regulators, in contrast with a single three-phase regulator, makes possible a lower investment in feeder copper.

This saving should be compared with the difference in the cost between a 3-phase regulator and three single-phase regulators. Individual or single-phase regulation is used most frequently in circuits where loads are predominantly single-phase and the express portions of the feeders are long. Lengths of the individual phases of the express and load area portions are shown to be equal in Fig 6. However, if they were unequal, the same method of analysis would apply.

Generally, regulating devices cannot be economically applied within the load area portion of the feeder to correct for the effects of unbalanced loads. Either the loads must be balanced, primaries shortened, larger copper used in the primary, or the voltage drop in transformers and secondaries at the end of the feeder must be reduced by increasing the size. Unequal voltage drops between phases in the *express* portion of a feeder can be corrected with single-phase regulators. This is because each single-phase regulator operates in accordance with the load conditions on its own phase. Unlike single-phase regulating banks, a 3-phase regulating device does not correct any voltage differences between phases.

Within a given load area being supplied by more than one feeder, the voltage spread over the entire load area should be equal to the difference between the upper and lower voltage limits. In other words, the voltage any customer *in the entire area* receives must be within the same

maximum voltage limits. Maximum voltage spread is the voltage difference between the first customer (that is, the customer receiving the highest voltage) on any phase of any feeder in the entire load area, and the last customer (that is, the customer receiving the lowest voltage) on any phase of any feeder in the entire load area.

It is common practice to use 3-phase regulation devices for bus regulation, although some bus regulated systems have each of the phases regulated independently with single-phase regulators. When 3-phase bus regulation is used and the difference between the voltage limits is 10%, full advantage of the permissible 3% voltage drop along the feeder between the first and last transformer on the individual phases or individual feeders can be realized provided the voltage drops in the express portions are equal at all times. The significance of this is shown in Fig 7. The voltage drops during peak load conditions are shown for the respective express and load area portions of each feeder. The unequal voltage drops in the express portions of the feeders may be assumed to be due either to unequal distances, unequal loads, or both. For a simple description of the basic principle it is assumed that each feeder is carrying a balanced three-phase load.

Example

Suppose the upper voltage limit, or the allowable maximum voltage, is 100% and the regulator is set to hold this voltage at the primary of the first transformer on feeder *Y*. To obtain this condition the station bus voltage must be 103%. Voltage at the last transformer on the same feeder, therefore, is 97%. This is the allowable minimum primary voltage to limit the total voltage spread between the first and last customer to 10%. With the voltage drop in the last transformer, secondary, and service added to the primary voltage drop during full load condition, the voltage the last customer on feeder *Y* receives is 90%. Thus, all customer voltages at the first transformer on feeders *X* and *Z* are 99 and 98% respectively; the primary voltages at the last transformer are 96 and 95% respectively. Hence, the last customer's voltages are 89 and 88% respectively. These voltages are 1 and 2%, respectively, below the minimum voltage limit.

Corrections to provide voltages in the load areas within the desired limits on feeders *X* and *Z* include: (1) Shortening load area portions of feeders *X* and *Z* until the voltage drops in the load area are 2 and 1% respectively; (2) Reducing loads on feeders *X* and *Z*; (3) Adding copper in express portions of feeders *X* and *Z*; (4) Increasing size of last transformers and secondaries to reduce voltage drops. With feeders *X* and *Z* changed by any one of the above methods so that the maximum voltage spread for the entire system is 10%, the maximum permissible voltage spreads for the individual feeders are: 9% in feeder *X*; 10% in feeder *Y*; and 8% in feeder *Z*. Had unbalanced voltages between phases been assumed, in addition, the permissible voltage spread for some of the individual phases would have been less than 8%.

Individual Phase Spreads

For bus regulated systems where the phase buses are regulated independently with three single-phase regulators, the permissible voltage spreads are determined the same way. In these cases, the permissible voltage spread of each phase of every feeder is determined individually instead of jointly determining the permissible voltage spread for the three phases of each feeder. If the phase voltage drops of the respective feeders are equal, then the permissible voltage spreads are the same as determined for 3-phase bus regulation.

By regulating the feeders with individual regulators the voltages at the first transformers of feeders *X* and *Z* could be held to 100% and the voltage at the primaries of their respective last transformers would be the desired minimum of 97%. When 4-kv feeders are connected to a large substation, experience shows that usually it is more economical to use individual feeder regulation.

As load areas grow and express portions of feeders become longer and longer, the unbalance in voltage drop in the express portion of feeders becomes more pronounced. With the trend towards smaller substations located closer to the load center, the voltage drop in the express portion of feeders is virtually eliminated.

For example, a voltage unbalance of 1% in the express portion of a 4-kv feeder can be effectively reduced to 0.1% if the power is transmitted over a subtransmission line at 13 kv to a small unit-substation at the load center. The 1% voltage drop due to unbalanced loads must be deducted from the permissible voltage spread in determining the calculated design voltage limits. The 0.1% becomes insignificant. Thus, if a substation is close to the load center and unequal voltage drops either between phases or feeder are sufficiently small, it is often possible to revert to 3-phase or bus regulation instead of using individual phase or feeder regulation.

Must Include Band Width

The foregoing discussions are based upon the assumption that the regulating devices will hold the voltage at the desired value with a zero tolerance. Any operating tolerances must be allowed for in the design of the circuit voltage drops. Present day regulating devices are adjusted to hold a desired voltage within plus or minus 1% or less. Thus, the regulating devices do not start to correct voltage until the voltage it is holding has changed 1%. The voltage spread during which the regulator remains inactive is the band width of the voltage regulating relay of the regulator.

The voltage drop profile in Fig 2 shows a permissible voltage drop of 3% in the feeder primary in the load area, assuming that the regulating device has a zero band width. If the same feeder were regulated by a regulating device with a plus or minus 1% (or 2%) band width, as shown in Fig 8, the resultant voltage spread is 12% instead of 10%. To keep a 10% voltage spread, the permissible voltage drops in the circuit must be reduced 2%.

If the control circuit of the regulating device contains inherent inaccuracies, such as in the voltage regulating relay, current transformer, potential transformer, or compensator, the edges of the band width will not remain at fixed voltage values. It is then possible, depending upon the error, for the voltage to drift more than plus or minus 1% from the value desired to be held before the regulator begins to correct the voltage. In effect, the band width

(Continued on page 139)

Reducing Percent Reactance of Supply Circuit Aids Synchronous Motor

Reconnection at 440 v reduces motor pull-outs and eliminates shutdowns . . . Volume of material handled approximately doubled

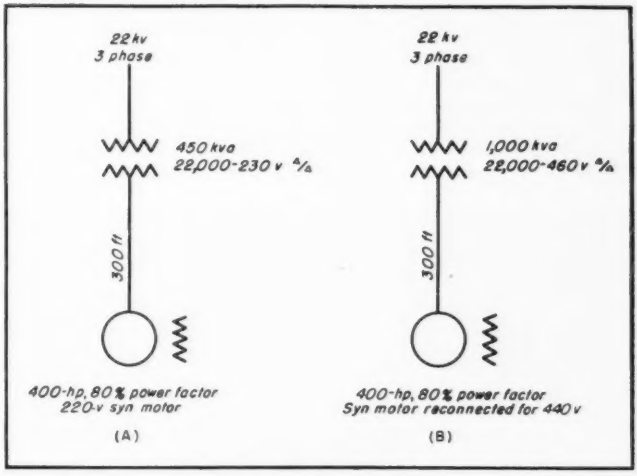
C. B. O'DONOVAN
Power Engineer
Duquesne Light Co, Pittsburgh, Pa.

REDUCING the reactance of the supply circuit by two-thirds greatly improved the performance of a synchronous motor driving a large scrap crusher. Benefits included increased production, fewer motor pull-outs and no motor shutdowns.

A scrap processor in the Pittsburgh area installed a large metal turnings crusher to increase production. A direct connected 400-hp, 80% power factor, 900-rpm, 220-v, 3-phase, 60-cycle synchronous motor with full voltage magnetic control was applied to drive the machine. A synchronous motor was chosen since this type was more readily available at the time. Existing electrical equipment was supplied at 220 v, 3-phase. However, there was little data available on which to base an accurate estimate of the horsepower required for the job. Power is supplied from a 22-kv transmission line through a 450-kva transformer bank and about 300 ft of secondary circuit, as shown.

Scrap is supplied to the machine by a clam shell bucket and the crushed turnings are removed by a mechanical conveyor. Soon after the equipment was placed in operation it was found that the motor would often pull out of step from the shock load of a bucket full of material dropping into the machine. Although the crusher had a large moment of inertia (25,500 lb ft squared) which was ten times that of the motor rotor, this inertia could not be utilized until the motor pulled out of step.

The motor control automatically removed the field on pull-outs and automatically reapplied the field to resynchronize when the motor had accelerated to a favorable speed. The interval between buckets was long enough to allow resynchronization but the acceleration was slow and the current during this period was high. As a result, the motor would often be shut down by the operation of its thermal relays. If the shutdown were not noticed promptly, a clogged crusher would result in a long delay.



COMPARISON of supply circuits for 400-hp synchronous motor directly connected to scrap crusher. (A) Original conditions. (B) After changes to improve operation

Effect of Voltage Changeover On Motor Performance

Factor	220-v Operation	440-v Operation
Reactance in percent of motor volts and amperes:		
Transformer Bank, %	4.5	1.9
Secondary Circuit, %	3.8	0.9
Total, %	8.3	2.9
Duration of test, min	48	58
Number of buckets	52	91
Number of motor pull-outs	17	2
Total time running out-of-step	3 min	4 sec
Number of motor shutdowns	4	0

After over-excitation of the motor field was tried without success, it appeared that the inability of the motor to carry its load might be due to the reactance of the supply. It was found that the percent reactance could be reduced to about one-third of its original value by the installation of a 1,000-kva transformer bank, changing the secondary voltage and reconnecting the motor for 440 v. Relative performance is shown in the table. The change in voltage alone resulted in a 75% reduction in the percent reactance of the secondary circuit.

Test results before and after the change showed these improvements: (1) About twice the volume of material crushed; (2) motor shutdowns eliminated; (3) motor pull-outs reduced 90%; and (4) time running out of step decreased 97%.

The Invisible Balance Sheet

A little sermon on public relations in terms of the human values in the financial statement . . . How some items on the balance sheet look in the public eye

WARREN R. VOORHIS
Now retired. At the writing of this article he was vice president, American Water Works & Electric Co.

A PROSPEROUS UTILITY is proud of its balance sheet. It is printed on folders and stamped on blotters: it waves from the masthead. It is necessary for a utility to have a balance sheet, but this admission leaves us free to say that a balance sheet is a form of literature distinguished by a conspicuous lack of charm.

It is an invention of accountants, an unimaginative tribe, and is an attempt to picture a business by arithmetic, a medium which is deficient in flexibility. Figures may be made to tell the truth; they cannot be made to tell the whole truth.

PEOPLE are the determining figures on the invisible balance sheet of a utility

It may be truthfully said of one of Sargent's pictures that it is 4-ft high and 5-ft wide, and contains 20 sq ft of canvas; but these statistics do not fully develop the idea of the picture.

I do not say that a certain amount of information about a utility cannot be gathered from a balance sheet by those who are trained to that somewhat dismal trade, but I do assert that some very valuable assets and some serious liabilities are never shown there.

I like to study the items of the balance sheet of a public utility with which I am acquainted; for example: "Station Grounds and Buildings, $290,000." This is an attempt by arithmetic to describe these buildings and structures.

But I see a sweep of broad brown river, curving about a level place set about with trees, with a high green hill rising behind it. The buildings are of gray slate, warm red brick, and white stone; the waters in the reservoir are shining in the sun. The driveways are marked with whitewashed stones, which is old fashioned, but green grass and whitewash are the cleanest combination in the world. The entrance gates are open and people sit about under the trees, and children run about in the grass with never a $5 fine sign to stumble over.

The chief engineer, tilted back in his chair by the door of the boiler house, watches the sun drop into the river. And the fireman's dog mitigates the austerity of his guardianship with a benevolent toleration for the rights of humanity. This pump station does more than pump water—it is a place of peace and quiet beauty. And the town is proud of it, as every town ought to be able to be proud of the buildings and grounds of its utilities.

You cannot see the open gates, and the whitewashed stones, and the green grass in the balance sheet, because beauty eludes words, as well as arithmetic. But as long as people continue to love such things, they should be listed in the "invisible balance sheet" as valuable assets.

One time I visited a utility property and was shown the balance sheet. One entry read: "Office Furniture and Fixtures, $6,000." My respect for the meticulous accuracy of accountants does not permit me to make actual changes in a balance sheet, but mentally I multiplied the $6,000 by three and transferred the whole item from the asset to the liability side of the balance sheet.

Those fixtures and that furniture produced in that office an atmosphere of settled permanent melancholy and solid gloom which remains in my memory to this day. The walls were painted a deep, durable green; the places from which calendars and pictures of candidates had been removed were lighter in color. The eye rested with relief upon a white place in the ceiling where the plaster had fallen away.

The Familiar Stove

The centerpiece of the office was the stove. From it a stovepipe wavered upward for 6 or 8 ft and then definitely angled away about 20 ft to a hole in the wall. This pipe was supported by rusty wires from the ceiling, and the wall around the hole was black with soot.

The space for the public was divided by a partition from the space for the inmates. There were two holes in this partition: over one it said, "Complaint Department"; over the other it said, "Pay Here." The linoleum in front of the complaint window was worn down to the bare boards. As a rule I am opposed to a "Complaint Department" in a utility office, but it did harmonize with this office.

In the public part there was never a bench or a chair where a woman could put her package or her baby while she fumbled for the bill she must produce at the "Pay Here" window. The wall desk for public use was so cleverly placed to avoid all light that it could not have been accidental. This was probably pure malice. Finally, the lower half of the front window was painted a dead black.

This article was originally published in ELECTRICAL WORLD 22 years ago. George A. Davis, president, Oklahoma Gas & Electric Co, came upon it a few months back while looking over some old files in the company library. He was again impressed with it, as he had been when he first read it in our April 10, 1926 issue. He suggested it be reprinted.

Yesterday, today and tomorrow, the problem of public understanding was, is and will be with the utility industry. What was good sense on that problem in years past is good sense now and will ever remain. We believe Mr. Voorhis' article is packed with good sense. We thank Mr. Davis for his suggestion. And we feel that thoughtful people in the utility industry will add their thanks to ours.—*The Editors*

A man in that town told me that once, when he went to this office to pay his bill, he took his dog along. And that man said that all the time he was there this dog just sat and howled and would not be comforted until he was once more out in the sunshine. I do not think that the man intended me to take this story literally, but he did mean to tell me how that office affected him, and just made up the part about the dog.

Now in the "invisible balance sheet" where should this furniture and these fixtures be placed? As long as people get impressions from material things, as long as they are affected by their surroundings, such an office is a heavy, self-inflicted liability, regardless of accountants and arithmetic.

Chief Engineer's Salary

I have been looking at the income account of a utility that I know very well. An "income account" is another contrivance of accountants, with the same limitation as the balance sheet. There is an item: "Chief Engineer's Salary, $4,200." This is the best the accountants can do for John Evans. The service record in our office shows that John Evans began work on April 20, 1886, at the station where he is now chief engineer. Forty years—a working lifetime spent in one place; doing one thing.

Whenever I go to this plant, Evans always says to me, "In 40 years the town has never been out of water, even for one hour." Every time I go there he says this to me. I suppose because he is old now and he forgets that he has told me before. But I think it expresses the dominant note in his life. It expresses his lifelong conscientious fidelity to a responsibility, although John Evans would not dream of putting his day's work in this stilted language and, besides, his repeated expression is much more simple and strong than mine.

Evans has witnessed ten changes of city government in his time, and for many years the young fire chiefs, driving red automobiles against traffic rules, have come out to the station to talk things over with Evans. New plant managers come, stay their appointed time and depart upon their lawful occasions, and Evans patiently undertakes the education of a new manager, who, if he is a wise young man, will give nearly as much heed to Evans as to the advice from the experts of the home office.

The Moral of Evans

As the years pass the whole organization has become proud of John Evans, proud of his long service, his experienced and knowledge of the property, and now, after 40 years, that town is proud of John Evans. He has become a public institution, like the Soldiers' Monument. And the Mayor, who has a fine turn for oratory, says that such a record reflects credit upon Evans and his company and that such loyalty and fidelity and such respect and confidence is the kind of relationship that ought to prevail in all industrial life.

And all the time Evans, a bent man with grayish hair, and the pipe he brought with him to the job, goes about his day's work at the station, one day being much like another. And he says, if you interrupt him, "In 40 years the town has never been out of water, even for an hour."

I conclude, from thinking of John Evans, that in the making of a man the size of the stage does not matter. Evans lives in a house near the station. He brought his wife there, and from there his children have gone out to lives of usefulness. He has spent all his years at his home or at the station, by the margin of a quiet river

(*Continued on page 151*)

Study of Switching Faults Improves Operation

Observance of rules formulated by a step-by-step review of each switching difficulty has eliminated break-downs, flash-overs and other system disturbances in recent years

CHARLES McNAMARA
Load Dispatcher
Commonwealth Edison Co, Chicago

SWITCHING LOADS around on the company's underground lines, a daily problem to the system operators, is normally and in a very high percentage of cases accomplished without any trouble. However, on what may be considered a normal switching operation, trouble of one kind or another has been experienced occasionally. By reviewing and analyzing these cases, it is possible in many instances to understand their causes and thus avoid repeating them.

On this underground system, located within the city limits of Chicago, the generating stations and distribution centers are tied together by an underground 66-kv cable system which is equivalent to a double circuit bus structure. There are four generating stations and two distribution centers normally operating on two common bus sections each approximately thirty miles in length, as indicated in Fig 1.

When switching difficulties do occur, each step-by-step operation is reviewed and analyzed. This review is standard practice when anything other than normalcy prevails, whether or not there is equipment failure or an outage. One such difficulty occurred some time ago when a 66-kv bus was being de-energized. Referring to Fig 2, the oil circuit breaker connecting a 60-Mva transformer to the 12-kv bus had been opened, leaving the transformer and the 66-kv bus energized from a 3-phase underground cable. This cable, 9.1 miles of three single-conductor oil-filled cables, was energized from a 60-Mva

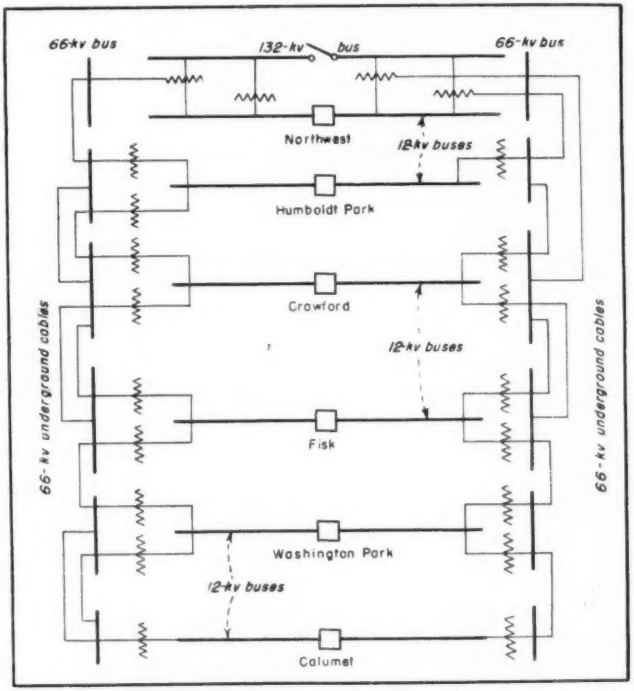


FIG 1—TWO COMMON BUS sections, each 30 miles in length and made up of 66-kv underground cables, are used to tie generating stations and distribution centers together

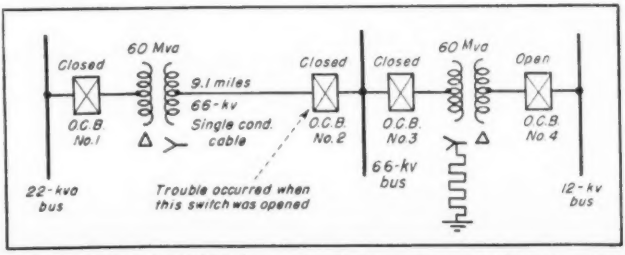


FIG 2—EXCESSIVE VOLTAGE rise, resulting from trapped energy in 60-Mva transformer when OCB No. 2 was opened, caused a flashover between 66-kv bus and ground

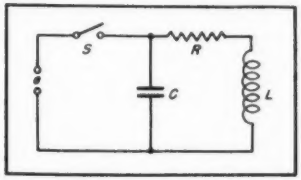


FIG 3—SIMPLIFIED circuit illustrates factors which cause the 66-kv bus flashover

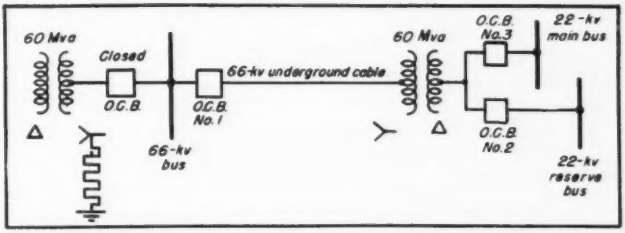


FIG 4—ENERGIZING underground cable and 60-mva transformer by closing OCB No. 1 at 66-kv bus, caused flashovers at OCB Nos. 2 and 3 at 22-kv bus

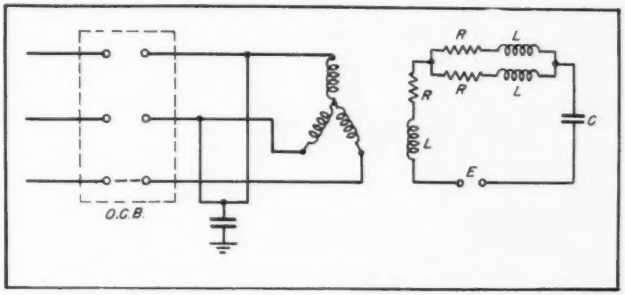


FIG 5—SIMPLIFIED DIAGRAM of series resonant circuit which caused OCB flashovers

transformer bank connected to a 22-kv generator bus through an oil circuit breaker. The final switching operation, the opening of the oil circuit breaker separating the underground cable and the 66-kv bus and associated transformer, resulted in a fault bus operation on the 66-kv bus which signified a breakdown to ground. Subsequent investigation disclosed a flash-over to the grounded metal bus structure over a B-phase bus insulator.

A possible explanation of this occurrence is found when the transformer is considered as a reservoir of energy: When a transformer is de-energized and no discharge path is available, through which the magnetic energy stored in the transformer may be dissipated, the trapped energy may cause dangerous over-voltages. A simple illustration (Fig 3) may help to explain how this takes place. Let L represent the highly inductive transformer winding, R, the resistance of the winding and leads, C, the capacitance of the winding and leads, and S, the switch to be opened to de-energize the transformer. The energy stored in an inductance is expressed by the formula, $\frac{1}{2}LI^2$; in a condenser, $\frac{1}{2}CE^2$. When the switch is opened the energy stored in the inductance tends to flow into the condenser. If we assume this transformation to be complete then $\frac{1}{2}LI^2$ must equal $\frac{1}{2}CE^2$. Such an assumption of course, is not altogether valid but it is useful to indicate the trend. Now if C is small compared with L (as it is in a transformer) then E, the only value in the expression for energy stored in the condenser which can change, has to become very high, and may become high enough to cause flash-over or insulation breakdown.

To prevent such a voltage rise, it is desirable to de-energize the transformer in such a manner as to have sufficient capacitance connected to it to absorb the trapped energy without the necessity of a dangerous voltage rise. This condition is realized when the switch used to de-energize the transformer is connected to it by a relatively long length of cable. If, in this case, oil circuit breaker No. 1 had been opened to de-energize the two 60-kva transformers, the underground cable section and the 66-kv bus, no trouble would have been experienced.

It is also possible to get into trouble while energizing equipment. The 66-kv underground cable and connected transformer shown in Fig 4 were being energized from the 66-kv bus. When oil circuit breaker No. 1 was closed, flash-overs to ground occurred on A-phase and B-phase bushings on the transformer side of 22-kv oil circuit breaker No. 2, and on B-phase of oil circuit breaker No. 3. Subsequent studies and tests indicated that C-phase of circuit breaker No. 1 must have closed an appreciable time interval before the other two phases. This action set up a series resonant circuit and the resultant high voltage caused these flash-overs. Fig 5 shows this circuit in simplified form.

If, in this type of circuit, X_c, the condensive reactance, is equal to X_L, the inductive reactance, they will cancel each other so that the current flow is limited only by the resistance, which, in a transformer, is very small. The resultant high current results in correspondingly high voltages across both the inductive and condensive portions of the circuit. These voltages may be many times greater than the normal operating voltage and may cause insulation break-down or flash-over. The vector diagram of the current and voltages in such a circuit is shown in Fig 6.

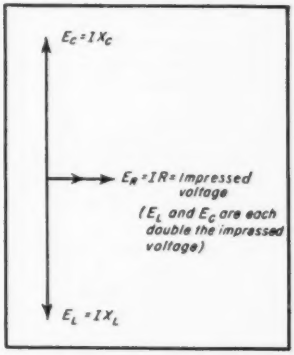


FIG 6—VECTORIAL analyses indicates voltages across inductive and condensive portions of the circuit may be double or more the impressed voltage

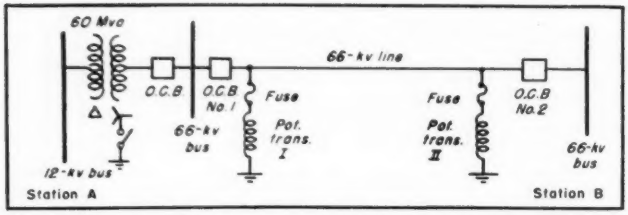


FIG 7—DE-ENERGIZING CIRCUIT by opening OCB's caused a chain reaction which included blowing of fuses, throwing of oil from OCB and a winding failure in a transformer

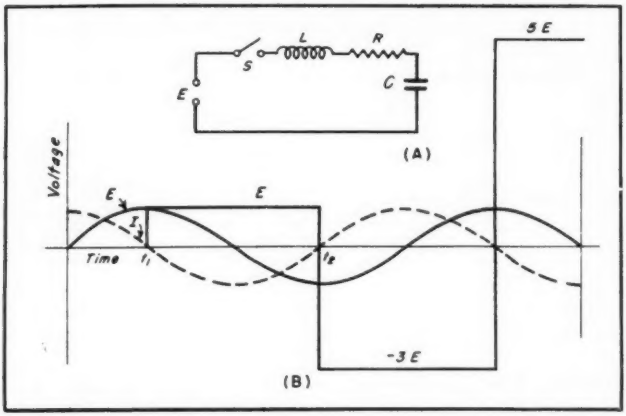


FIG 8—SIMPLIFIED DIAGRAM (A) illustrates components which caused the failures. *L* and *R* are very small in proportion to *C*. Square wave is voltage across condenser

The obvious remedy to this problem lies in the adjustment of circuit breaker No. 1 so as to get coincident closure on all three poles. Another possible solution would be to energize the circuit from either circuit breaker No. 2 or No. 3. However, the objection to this procedure is that there is no neutral connection available for the 66-kv portion of the circuit, and consequently no residual relay protection in event of ground fault.

Another switching experience resulted in a kind of chain reaction. The switching problem (Fig 7) was to de-energize the 66-kv line, a 3-phase line consisting of three single-conductor oil-filled underground cables 6.6 miles long. An attempt to do this was made by opening oil circuit breaker No. 2 to unload the line and then opening oil circuit breaker No. 1 to de-energize it. When the second circuit breaker was opened, the potential transformer fuses blew at both ends of the line, the A-phase bus insulator on oil circuit breaker No. 1 flashed over, the A-phase oil circuit breaker on the 66-kv side of the transformer at station A discharged oil as it opened by relay, and a breakdown occurred between the 66-kv and 12-kv windings of the B-phase series windings in the regulating transformer at station A. The probable sequence of happenings and the conclusions are:

1. The first pole of circuit breaker No. 1 opened, leaving sufficient charge on the cable to blow the potential transformer fuses, these being the only paths by which the stored energy could escape.

2. The second pole of circuit breaker No. 1 opened, causing high voltage across *A*-phase bus insulator which broke down to ground.

3. The arc across this bus insulator caused a high voltage between the transformer windings which resulted in a breakdown between the neutral of the wye and B-phase of the 12-kv winding, providing a zero sequence path through the transformer.

4. The 66-kv circuit breaker on the transformer, in attempting to clear the bus fault, discharged oil upon opening.

The effect of a closed neutral connection would have been to reduce the magnitude and duration of the transient over-voltages.

The over-voltage in this instance was caused by interrupting the current flowing in a circuit containing capacitance, inductance, and resistance, in which the capacitance was large in proportion to the inductance. Such a circuit is formed by a section of underground cable and its bus connections. If the current in such a circuit is interrupted at the zero point of its cycle and a re-strike of the arc occurs, it will probably be reestablished at the next current-zero point because the impressed voltage reaches its next peak at that time. If such a re-strike does occur, the voltage on the condenser portion of the circuit may rise to three times normal value, and subsequent re-strikes at each succeeding half-cycle will cause a still greater voltage rise. The simple circuit sketched in Fig 8 (A) makes this phenomenon clear.

Voltage Buildup Across Condenser

Assume the switch, *S*, to be opened sometime prior to time t_1, the first current zero point after the time of opening the switch. The condenser, *C*, is charged at that time so the normal voltage, *E*, appears across it. Now if the arc is reestablished at time t_2, the time at which the next voltage peak occurs, the condenser voltage will attempt to change to $-E$, but because of the inductance in the circuit, the voltage across the condenser may rise to three times normal value but in the opposite direction, or $-3E$. If the current is again interrupted at the next current-zero point, time t_3, the voltage across the condenser can, in a similar manner, reach five times normal value, and so on for each successive re-strike. These values are theoretical maximums and are probably considerably lower in practical cases, but they still may be high enough to cause insulation break-down or flash-overs.

In spite of difficulties of analysis, certain rules for guidance in switching may be stated, some drawn from the theories outlined above, and others drawn from experience. Briefly, they are:

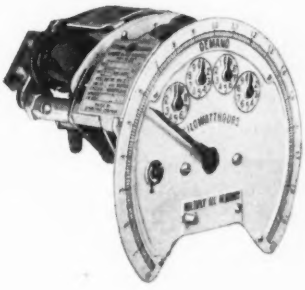
A. *De-energizing Transformers.* In cases where a transformer must be de-energized from a single cable of

(Continued from page 151)

General Electric Announces

2 New Simplified Demand Registers . .

. . will help you save money by decreasing maintenance costs



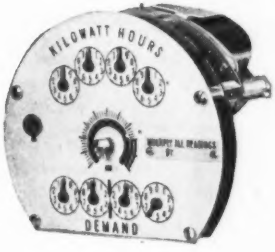
M-30 indicating demand register

This is a block-interval type of demand meter embodied within a register. It is available to replace the standard kilowatthour registers on a large variety of a-c watthour meters.* It integrates kilowatthours and gives the maximum demand during each reading period.

Your maintenance costs will be low because the timing motor, through a novel application of the Geneva mechanism, resets the pointer-pusher by direct-drive gearing, thereby eliminating the need for the spring and latch mechanism found in conventional demand registers. Internal resetting is accomplished with precision and freedom from shock.

Liberal spacing of plates, shafts, and gears gives maximum visibility for inspection. Very substantial plates, plus parallel arrangement of shafts, insure perfect alignment of parts and stability of bearings with minimum adjustments.

A wide, flat pointer with knife edge combines visibility and precision reading with minimum parallax.



M-31 cumulative demand register

This block-interval demand register (of the same basic construction as the M-30) indicates maximum demand during the reading period (usually one month) as well as the cumulated value of previous maximum demands. It has the advantage of leaving maximum demand for one period available for reference during the entire following reading period.

THESE REGISTERS lend themselves admirably to standardization and stock simplification. Also, you're assured of easier inspection and testing because of the fewer parts, interchangeable register timing motors (120- and 240-volt), and over-all simplification.

Let these features start saving money for you. Place an order with your nearest G-E representative today.

**Complete details on the M-30 in Bulletin GEC-413, M-31 in Bulletin GEC-272. Write for your copies now.*

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GENERAL ELECTRIC

091-41

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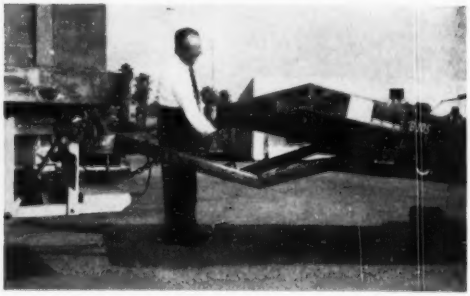
Tilting Trailer Simplifies Tractor Loading

TILTING TRAILER becomes ramp for unloading and loading light tractor used by Southern California Edison Co for light construction jobs. One man can load or unload tractor; drive truck from job to job. Hinged license plate clears tractor wheels



HINGED OFFSET DRAWBAR is kept in traveling position by two pins which are removed to allow trailer to tilt as tractor backs up. Drawbar remains coupled to truck. Prior to reloading of tractor, the trailer must be tipped down from unloaded position

E. B. RYNN
Supt. Substation Construction
Southern California Edison Co

SOUTHERN CALIFORNIA EDISON is using a tilting trailer to transport a small tractor from job to job. With it one man can load or unload the tractor without any special blocks or beams.

The single axle trailer acts like a seesaw. In traveling position the bed is level, with center of gravity of the tractor between the axle and drawbar. The drawbar is hinged under the bed of the trailer three feet back of the platform edge, as shown. It is held in traveling position by two pins at the platform edge. To unload the trailer these pins are removed, but the drawbar remains connected to the truck.

After removing the wheel blocks which keep the tractor from rolling, the operator backs slowly past the axle. The shift in weight causes the rear end of the trailer to drop to the ground, making an ideal ramp.

After the tractor is backed off, the trailer resumes its horizontal position so it can be moved as required. When the tractor has completed its job, the trailer is tipped down and the tractor driven right back on it.

Edison has found this small size tractor valuable in substation or other light construction. It is used for excavating, digging post holes, scraping, scarifying and as a light bulldozer.

One man drives the truck from one job to another and operates the tractor on the job. Extreme mobility with minimum manpower required add up to a piece of versatile equipment.

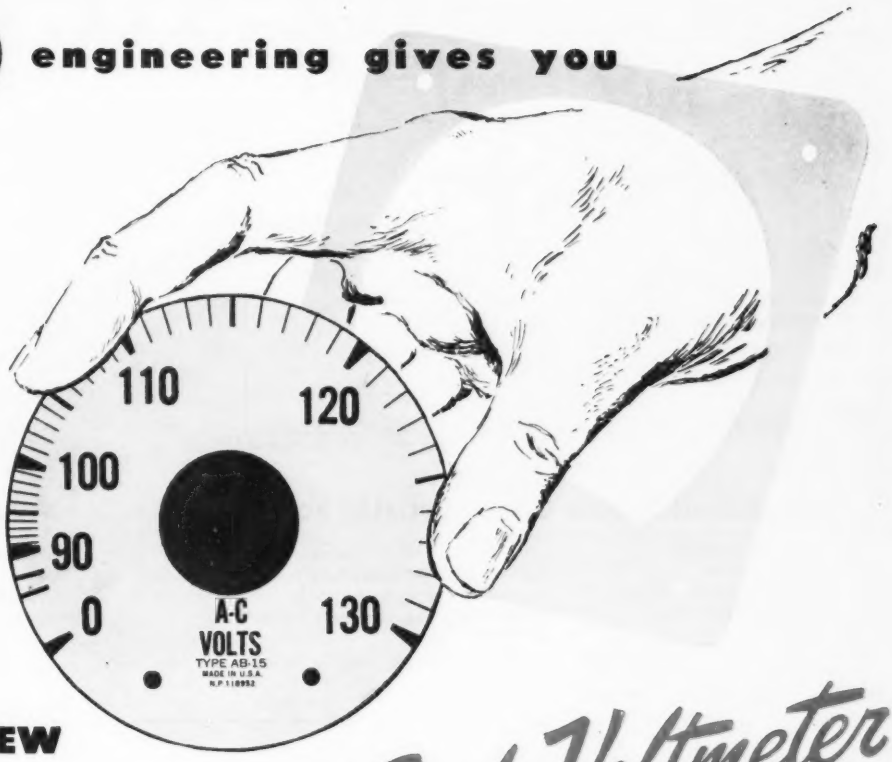
Rotating-Beam Fatigue Tester Designed for Wire

BY THE DESIGN of a new fatigue testing instrument, data can be obtained so that stress (at the peak of the loop) of small-diameter wire can be predicted, and brought to as great a value as desired in order to hasten specimen failure. The device known as the rotating-beam fatigue tester was developed by Hunter Spring Co, Lansdale, Pa. It is operated on a 110-v, 60-cycle circuit.

The instrument is adaptable to wires ranging in diameters from 0.005 to 0.030 in. For the tests a sample of predetermined length is looped through 180 deg and rotated at 3600 rpm. Provision is made by means of a sliding chord plate for the loop or arc to have chord lengths ranging from 1 to 10 in. at 1-in. increments and with vernier adjustment to 0.001 in.

This test unit consists of a ball-bearing synchronous motor driving a chuck at 3600 rpm and a bushing to position the end of the specimen not clamped in the chuck. The bushing can be positioned with vernier accuracy to 0.001 in. which is indicated on a dial instrument. Two wire bushing assemblies are used: one for non-magnetic specimen which requires a bent end, and the other equipped with alnico magnet to hold magnetic material. Two guides or supports mounted on alnico magnets hold the

engineering gives you



A NEW

Expanded-Scale Voltmeter

FOR MORE ACCURATE READINGS OF IMPORTANT CIRCUIT VOLTAGES

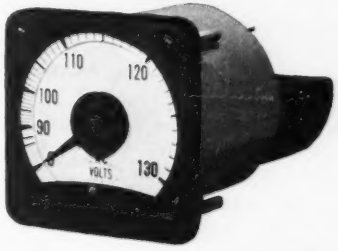
THIS is our answer to your long-standing need for a stable, reliable instrument to measure accurately important a-c circuit voltages in power-generating stations, substations, or industrial test installations. From 105 to 125 volts (the range most commonly used) the scale of this instrument has been expanded . . . stretched out. It has an accuracy of ± ½ of 1% over the range normally used, and ± 1% at other marked points on the scale.

Its high operating torque gives it this great accuracy plus a fast response time (less than one second for full-scale deflection), and the anti-parallax scale and pointer are further aids to easy, accurate readings. The circular mask serves to emphasize the scale and pointer.

STABLE DESIGN—It has an electrodynamometer mechanism with a saturable reactor—no vacuum tubes or rectifier. Spring-mounted jewels guard against shock. Ease and economy of servicing are assured by new "unit" design—entire moving element assembly can be replaced without disturbing calibration.

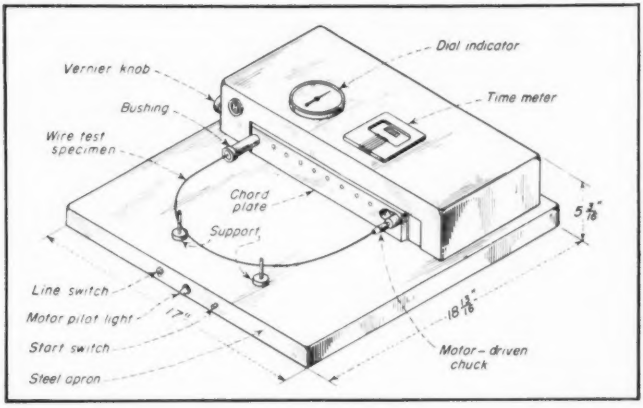
SMALL SIZE (only 4¼ inches square) permits mounting five instruments of this line on a panel only 24 inches wide.

Why take less when you can get all these features—plus the many other refinements found in all G-E instruments. Insist on the G-E long scale line when ordering your switchboards, and be sure of the best. Write for bulletin GEC-218. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



Also available as a-c ammeter, a-c wattmeter, d-c voltmeter, d-c ammeter, temperature indicator, power-factor meter, synchroscope, and frequency meter.

GENERAL ELECTRIC



specimen in a horizonal plane and prevent vibration. They can be positioned anywhere on the steel apron.

Revolutions of the synchronous motor are counted by a timer which is read in tenths of a minute. The test is automatically terminated as the specimen breaks and actuates an electronic circuit to stop the motor and timer simultaneously.

The instrument is flat in design and permits easy rack mounting. Thus a compact bank of several units can be racked for conducting various tests at the same time.

FATIGUE TESTER developed for looped small-diameter wires rotates at 3,600 rpm

Modified Motor Characteristic Solves Bin Gate Drive

J. D. WRIGHT
Manager
Industrial Engineering Divisions
General Electric Co

As PART of the coal handling equipment for a complete new coal pier, 32 motor-operated bin gates were installed. Each was driven through gearing by a small 15-min rated, 2-hp, series-wound, d-c motor, using magnetic control and solenoid brake.

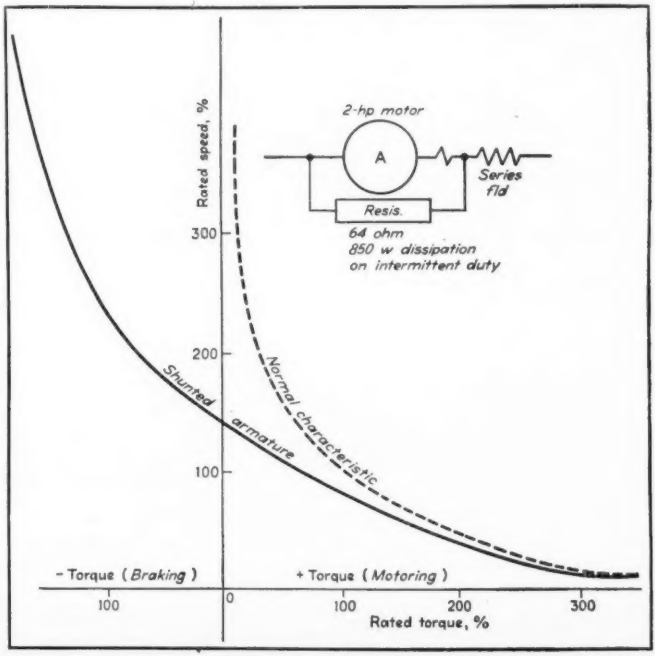
After the drive was placed in service, trouble was experienced with the operation of the gates. The solenoid brakes would not stop the closing movement of the gates quickly enough to prevent jamming. This caused frequent shearing of pins and damage to gears. Possible solutions that were considered included: (1) Changing the gear units on all 32 gates; (2) changing to lower speed motors; or (3) replacing existing brakes with oversize equipment.

Trouble Found by Analysis

But fortunately before any of these expensive changes were made, an engineering analysis was made of the operating conditions. This revealed that the motion of the gate was such that, when it started to close, there was full load on the motor. But this load decreased rapidly as the gate closed and was reduced almost to zero before reaching the fully closed position.

As shown by the dash line curve, when the load on a series motor is reduced its speed rises sharply. As a result, the normal size brake was unable to stop the overspeeded motor and gate.

The solution was simple, as explained before the May meeting of the Industrial Power Committee of Southeastern Electric Exchange. The speed-torque characteristic of the series motor was changed by shunting its armature with a 64-ohm re-



ARMATURE SHUNTING RESISTOR alters the normal speed-torque curve of a series-wound motor for driving bin gate. Analysis of operating conditions solved the problem

The Regulator you asked for!

We took stock! We made a careful digest of all comments and suggestions that we had received from you in the electric utility industry as to what you wanted in single-phase induction-voltage regulators.

The result: a new Type IRS Regulator—the regulator you asked for.

It still has the high accuracy, the narrow band width, and the immediate response that you praised in G-E regulators. It will continue to require practically no maintenance—the characteristic that has made the G-E induction voltage regulator one of the most dependable and satisfactory equipments on central-station lines.

And now it is . . .

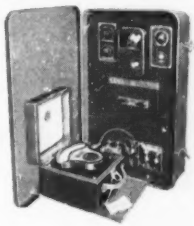
EASIER TO INSTALL!

- The new rectangular base provides greater stability, gives ample clearance for jacking and allows you to move the regulator in any direction on rollers.
- The clamp-type bushing terminals accommodate a wider range of cable sizes.
- New copper-faced ground pad has bolts spaced for NEMA terminals.

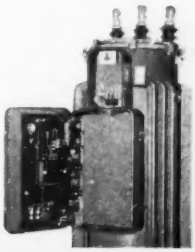
EASIER TO ADJUST!

- Adjustment for holding effect in voltage-regulating relay is now made with a single-dial rheostat.
- Manual control now operates directly in the motor circuit.
- Terminals for current testing, as well as potential testing, are now conveniently located on front of panel.

Our new booklet GEA-2985 contains a complete description of this new regulator. If you have not received your copy, write your nearest G-E district office or *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*



You asked for a place to put testing instrument. The new regulator has a shelf built into the control cabinet door which locks the door open, keeps it from swinging, and at the same time provides a handy place for portable instruments. Note the good appearance of the semi-flush control panel.



You asked for more accessibility. In the new regulator, the entire control panel swings open, exposing all the wiring and connections making all control components readily accessible for maintenance and inspection.

GENERAL ELECTRIC

NOW ... PROVED BY 12-MONTH

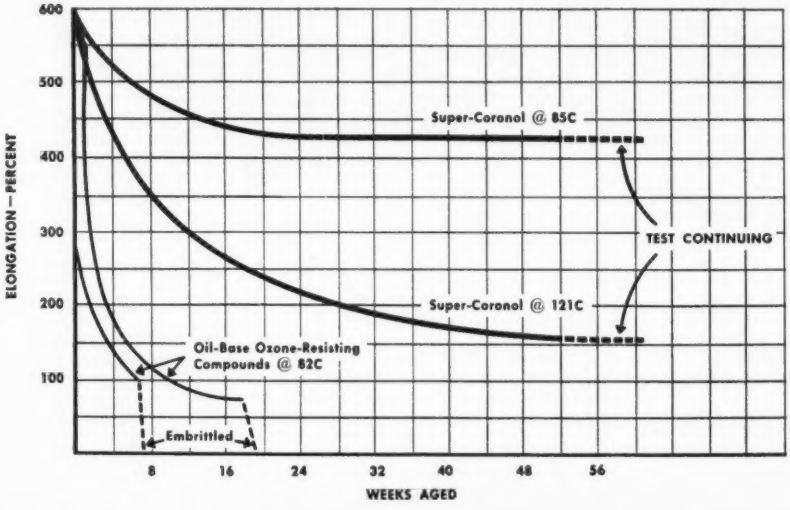
CORONOL-GEOPRENE

outlasts other cables 3 to 1 at higher temperatures!

Here's additional proof of the superior aging properties of Coronol-Geoprene, General Electric's rubber-type high-voltage power cable. Aging tests now covering a full 12-month period—and still continuing—prove beyond doubt that its Super Coronol insulation stands up at higher operating temperatures where other cable insulations fail.

Note the story told by the curves on the chart. At 85 C and 121 C, Super Coronol's special butyl-base compound lasts longer than other oil-base compounds at 82 C—*at least three times longer!* In addition, it provides an ample margin of safety over its recommended 80 C rating.

LIFE TEST OF RUBBER INSULATIONS



In this test, other insulations gave out at 82 C after 7 and 19 weeks. At 85 C and 121 C, Super Coronol insulation was still going strong after a full year. Even at its higher temperatures, Super Coronol's life was *three times longer!*

AGING TESTS:

CABLE

BOOSTS LOAD CAPACITY

Coronol-Geoprene is the only known rubber-type cable unreservedly recommended for 80 C operation up to 15 kv. That means you get higher current-carrying capacity in the same cable size, or reduced cable weight and cost through use of smaller sizes. And its excellent resistance to corona and ozone, to moisture and heat, make it ideal for all high-voltage applications.

TOUGH—BUT HANDLES EASILY

Moreover, the Geoprene outer jacket on this G-E cable is more than twice as tough as the best prewar natural rubber jackets. Yet it's lighter, more flexible, and easier to handle than metal-clad cables, saving installation time and cost. For more data, send for Bulletin GEA-1788, "Some Facts About Super Coronol." *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

MORE POWER AT 80 C WITH SUPER CORONOL

Size in AWG or MCM	Amperes, three insulated conductors in single exposed or enclosed conduit; 40 C ambient			
	0–8000 Volts		8001–15000 Volts	
	75 C Copper Temp.*	80 C Copper Temp.	70 C Copper Temp.	80 C Copper Temp.
8	43	46	...	...
6	57	60	62	70
4	76	80	77	87
2	101	107	98	111
1	115	122	113	129
0	133	141	130	148
00	152	161	150	171
000	175	186	173	197
0000	203	215	199	227
250	225	239	220	250
350	274	290	267	302
500	336	357	323	368
750	418	442	398	452

*Except for Super Coronol, the maximum rating of all high voltage rubber insulations is 75 C up to 8000 volts, 70 C above 8000 volts.

GENERAL ELECTRIC

sistor. The solid-line curve shows the result. Even when the load torque drops to zero, the motor speed is held down to 140% of normal. The normal brake was then adequate for the duty.

Thus a serious operating difficulty was solved by securing accurate knowledge of the load and using small inexpensive resistors to modify the motor characteristic so that it properly fits the application.

Influence of Weather on System Load

K. M. LOVEWELL
System Planning Division
Potomac Electric Power Co
Washington, D. C.

VARIATIONS in weather from month to month have a substantial effect upon sales of energy and therefore revenue. Such fluctuations can amount to several percent compared with normal. It follows that monthly estimates of sales and revenues which must be based on average conditions will be in error to the extent of these variations.

Management needs current explanations of variations in business. Engineers following load growth trends must note changes to a high degree of accuracy. The bigger the system the more important the accuracy. Such needs are supplied by a method developed by the System Planning Division of PEPCo.

In determining what the actual load growth was for any particular month over the same month the previous year, consideration is to be given on what the effect of the weather was for the same two periods. In reviewing the past trends on load increases, they may be projected for the future.

Electrical load increases with decreased light intensity and varies in a more complicated way with the temperature and relative humidity. The psychrometric chart (Fig 1) gives the heat content of the atmosphere. For example, a dry bulb temperature of 80 F and a relative humidity of 60% gives 33.8 Btu per lb of dry air.

Fig 2 gives the load in relation to heat content and light intensity (or sunlight) for the four seasons. This group of curves has been drawn for the locality of Washington, D. C.

From these curves are determined the kilowatthour difference in any two months due to weather alone. This is done by setting down the daily loads indicated by the curves for the weather conditions that actually existed for each day of each month, adding the loads for each month and comparing the two monthly totals.

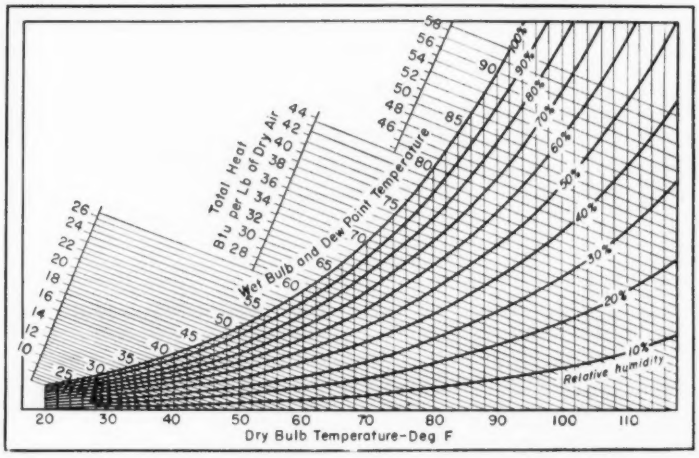


FIG 1—**PSYCHROMETRIC CHART** gives total heat for temperature and humidity

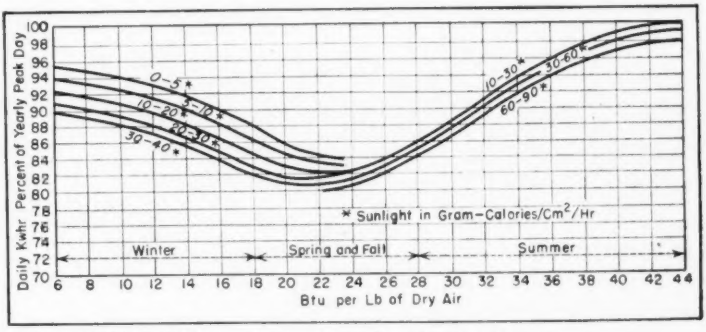


FIG 2—**SYSTEM LOAD** is indicated for weather conditions throughout the entire year

For that purpose data are tabulated as follows: Date, day, average dry bulb temperature, average relative humidity, Btu per lb of dry air, average gram-calories per cm² per hour and percent load.

If the actual load increase, for example, was 10% and the curves indicate 2%, then the actual growth was 8%. If the curves indicate minus 2%, then the actual growth was 12%.

For other localities the following is a guide in the assembly of data and development of curves. Weather data, same as for the foregoing calculations, are based on the published monthly reports by the U. S. Weather Bureau. Dry bulb temperature and relative humidity values are averaged for four readings a day at 6-hr intervals. System load indicating curves are drawn through the load points which represent days of similar light intensity. The average intensity for the daylight hours was used for each day. Only the week days, Monday through Friday, were used for determining the curves.

SEE REVERE

FOR CONDENSER TUBES AND PLATES

EXPERIENCE has proved that in a majority of installations Revere Admiralty Metal condenser tubes, inhibited to resist dezincification, will give long, satisfactory and economical service. However, Revere also makes tubes in Cupro-Nickel, Revalon (aluminum brass), Red Brass, Muntz Metal, Arsenical Copper, and Copper, thus enabling you to select the Revere Metal or Alloy best suited to meet your operating conditions.

In addition, Revere manufactures pipe and tube in copper and brass for general piping purposes, and electric welded steel tube.

Revere condenser plates can be had in a number of alloys in squares, rectangles, circles, half-circles, segments, and special patterns. These plates are flat, dense, free from blow holes or other imperfections, accurate in gauge, and are easily machinable.

As each condenser, heat exchanger or other piece of equipment using tubes and plates presents an individual combination of conditions, no blanket recommendations are possible. Among the factors to be considered are: chemical and impingement attack, velocities, pressures, temperatures, air entrainment, suspended solids. Should short tube life or other circumstances lead you to question your present practices, the Revere Technical Advisory Service will gladly cooperate with you in making thorough field and laboratory studies, to assist you to determine the most serviceable and economical alloys.

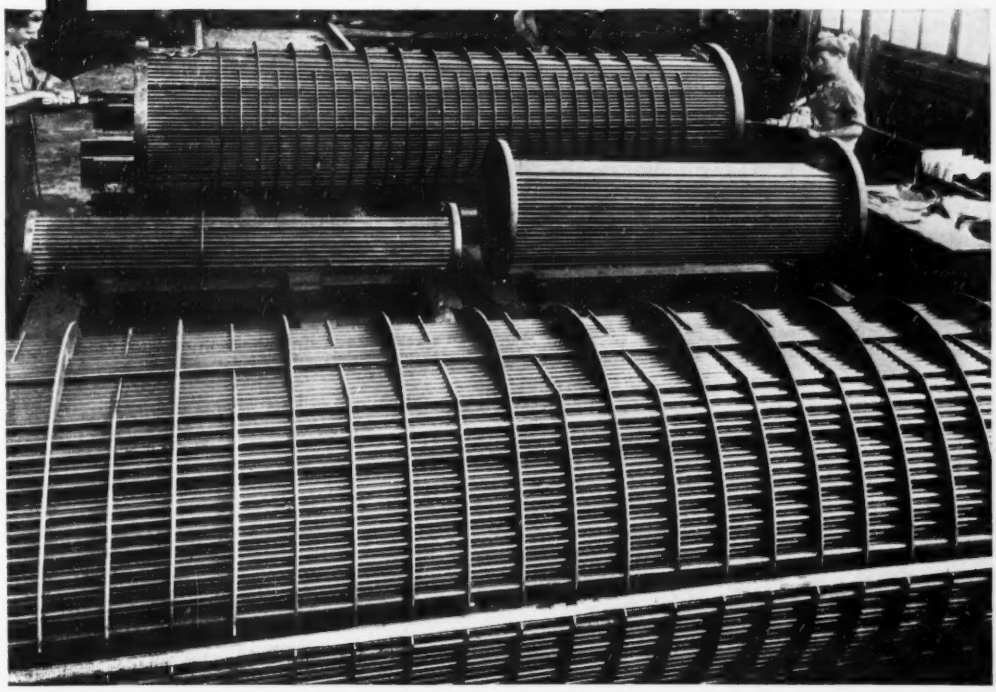
REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.



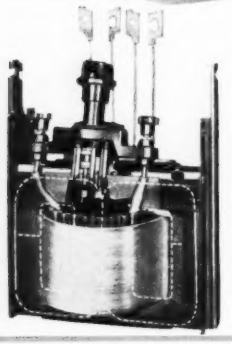
THE *NEW* MOLONEY

HiperCore*

DISTRIBUTION TRANSFORMERS

*CORES MADE OF HIGH PERMEABILITY, ORIENTED, SILICON STEEL

BETTER VOLTAGE



Dotted line in illustration at left, indicate position of core in assembled core-and-coil unit. After cores are wound, they are annealed, impregnated and then cut into pairs of U-shaped pieces. Two large U-shaped pieces are placed side by side, forming an inner and two outer core legs. Then the windings are placed over the inner core leg. Next, the two matching U-shaped pieces are placed into position to complete the magnetic circuits. A thermo-setting adhesive bonds the core faces together.

BETTER VOLTAGE REGULATION AT ALL LOADS

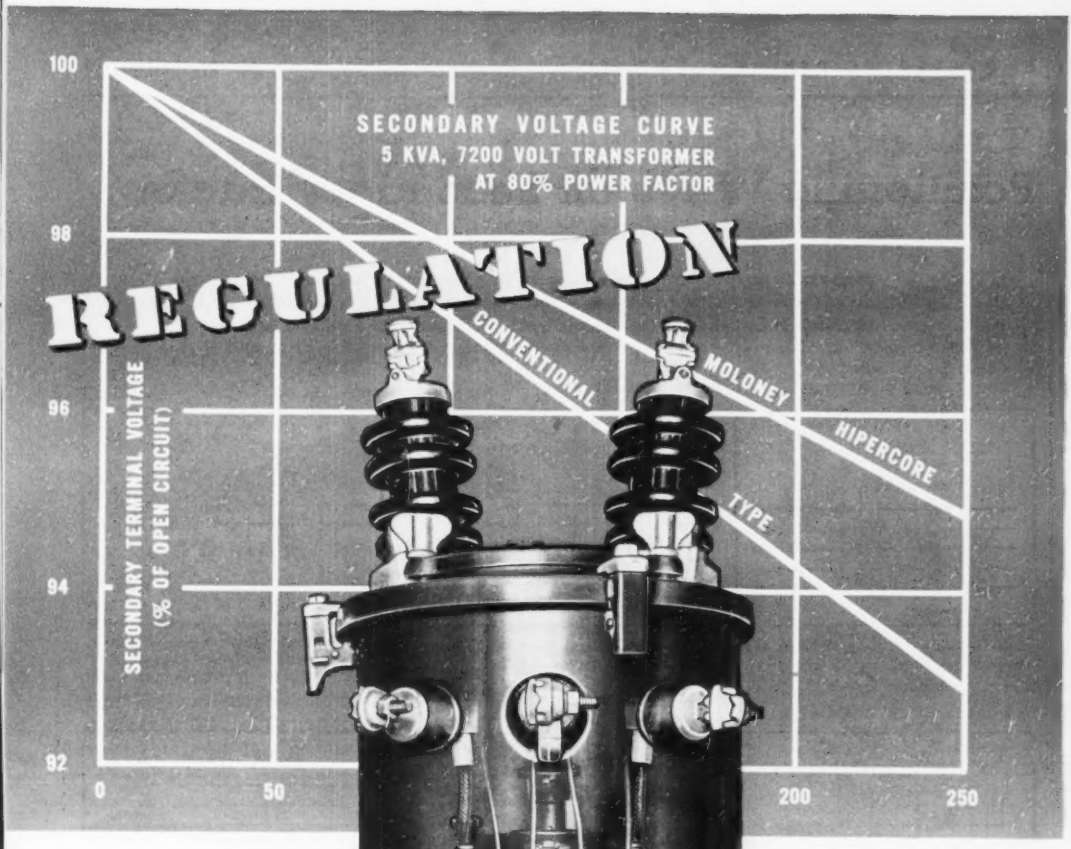
Development of the new Moloney HiperCore Transformer has made possible a reduction in transformer impedance, resulting in better voltage regulation. These wound core transformers, being smaller physically, have inherently lower impedance than transformers of conventional core design.

Better voltage regulation means better all-around system performance. Secondary voltage fluctuations, due to sudden or intermittent load changes, are reduced. Secondary voltages may be maintained at a higher level resulting in improved performance of the connected load.

In many installations emergency loading is controlled largely by transformer voltage regulation. Moloney HiperCore Distribution Transformers, having better regulation, can carry higher overloads with the same permissible voltage drop.

MOLONEY

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT



GREATER SHORT-TIME OVERLOAD CAPACITY

Moloney HiperCore Transformers have improved short-time overload characteristics which provide better peak load performance and longer life. Reduced coil mass, achieved through use of oriented steel cores, together with the extensive use of cooling ducts, results in more rapid cooling of the windings and in a lower hottest-spot temperature gradient.

LIGHTER WEIGHT

The 30% to 35% higher flux carrying capacity of the oriented core steel used in HiperCore Transformers makes possible the use of smaller cores and windings, with consequent reductions in the weights of steel, copper, oil, and other materials. HiperCore Transformers weigh 15% to 30% less than transformers having cores made of hot rolled steel, making them easier to handle and install.

SMALLER SIZE

Since the higher flux carrying capacity of oriented steel permits the use of smaller cores and windings, smaller tanks can be used. Reductions in size range up to 30%. HiperCore Transformers take up less space on the pole, in the storeroom, and on the line truck.

SUPERIOR TAP CHANGER DESIGN

The "snap action" movement of the tap changer used on Moloney HiperCore Transformers assures positive pressure at all times. The handle is above the hot oil level and the dial can be read from the handhole opening. The body of the tap changer is made of high-impact-strength phenolic resin for high insulation and elimination of breakage. Use of high contact pressure and oversize contact surfaces insures low temperature rise and eliminates pitting or burning.

ELECTRIC COMPANY

SAINT LOUIS 20, MISSOURI AND TORONTO, ONTARIO, CANADA

Positioning Wires on Secondary Racks

Sketches show rack arrangements for single-phase and three-phase conductors with neutral and switching wires. An adaptation from construction standards of Consolidated Gas Electric Light and Power Co of Baltimore, Md.

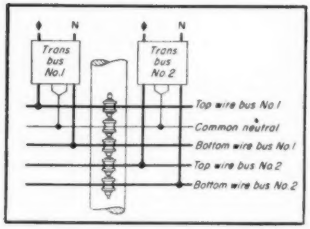


FIG 1—Two single-phase bus lines and common neutral on second spool

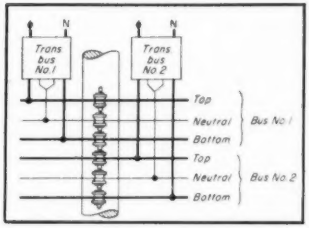


FIG 2—Two single-phase bus lines and separate neutrals for each bus

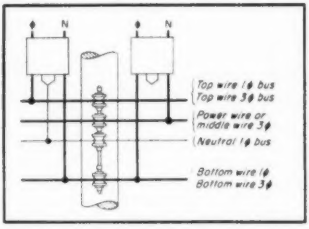


FIG 3—Single-phase bus lines with power wire or middle wire for three phase

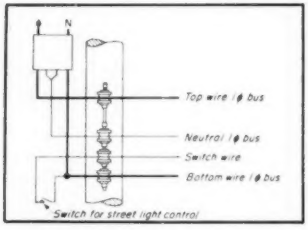


FIG 4—Single-phase bus lines with switch wire for street light control

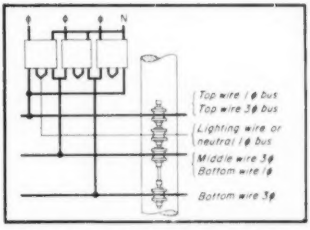


FIG 5—Three-phase 240-v bus with lighting wire or neutral of single phase bus

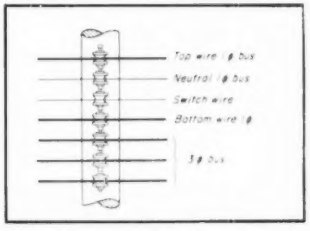


FIG 6—Single and three-phase bus with switch wire on third spool

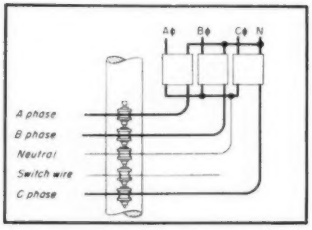


FIG 7—Three-phase, 4-wire, 120/208-v bus with switch wire

NOTES

On 3-phase services the power wire must occupy the center position at the condulet.

Use of two racks for construction involving bus lines is preferable to placing all the conductors on a single rack and should be used where the proper clearances can be maintained.

Placing of six and seven insulators on an 8-in. rack requires the use of a 36-in. bolt.

Any trade names and manufacturer's catalog numbers used in identifying items or materials are for descriptive purposes only, and equivalent articles produced by other firms are acceptable.

Aerial Cable Hardware Engineered for HARD WEAR

Messenger Splices and Dead Ends

Available in All Copperweld Messenger Sizes Up to and Including 9/16"

Automatic Type Series AMDE

The Automatic Messenger Dead Ends are cast in a high strength bronze that will hold messenger to the ultimate breaking load. Fully automatic, it requires only that the messenger be inserted. A slight tension automatically causes the gripping cone to hold securely.

Automatic Type Series AMS

The Automatic Messenger Splice is of high strength Duronze accurately designed and machined to hold Extra High Strength Copperweld Messenger to its ultimate breaking load. Fully automatic, it requires only that the messenger be inserted. A slight tension automatically causes the gripping cone to hold securely.

Nut Type Series MDE

The nut type messenger dead end is cast in high strength bronze that will hold the messenger to its ultimate breaking load. It is used to make a rigid assembly on the ground. Once tightened, any backlash occuring when pulling in the cable does not cause movement of the gripping cone.

Nut Type Series MS

The nut type messenger wire splice is cast in high strength bronze that will hold the messenger to its ultimate breaking load. It is used to make a rigid assembly on the ground. Once tightened any backlash occuring when pulling in the cable does not cause movement of the gripping cone.

Service Cable Dead End
Series SDE
(Flexible Bail Type)

The Service Cable Dead End (Flexible Bail Type) provides a neat, easily installed method of fastening the messenger of self-supporting service drop cable to the house bracket or secondary rack. Just loop it thru and it's there to stay. (Above photo shows actual installation.)

Aerial Cable Binding Tape Clamp–Type 221

Available in two sizes, covering the entire range of messengers up to and including 9/16", and commonly used ribbon tapes. Provides an excellent mechanical and electrical bonding between tape and messenger.

Aerial Cable Spinning Wire Clamp Spacer Bar Type (221-B2)

Where cable is lashed in the field, and small lashing wire is employed, it is recommended that a spacer type clamp be used. This clamp holds the lashing wire out of the messenger strands, and makes a good electrical and mechanical bond.

FARGO

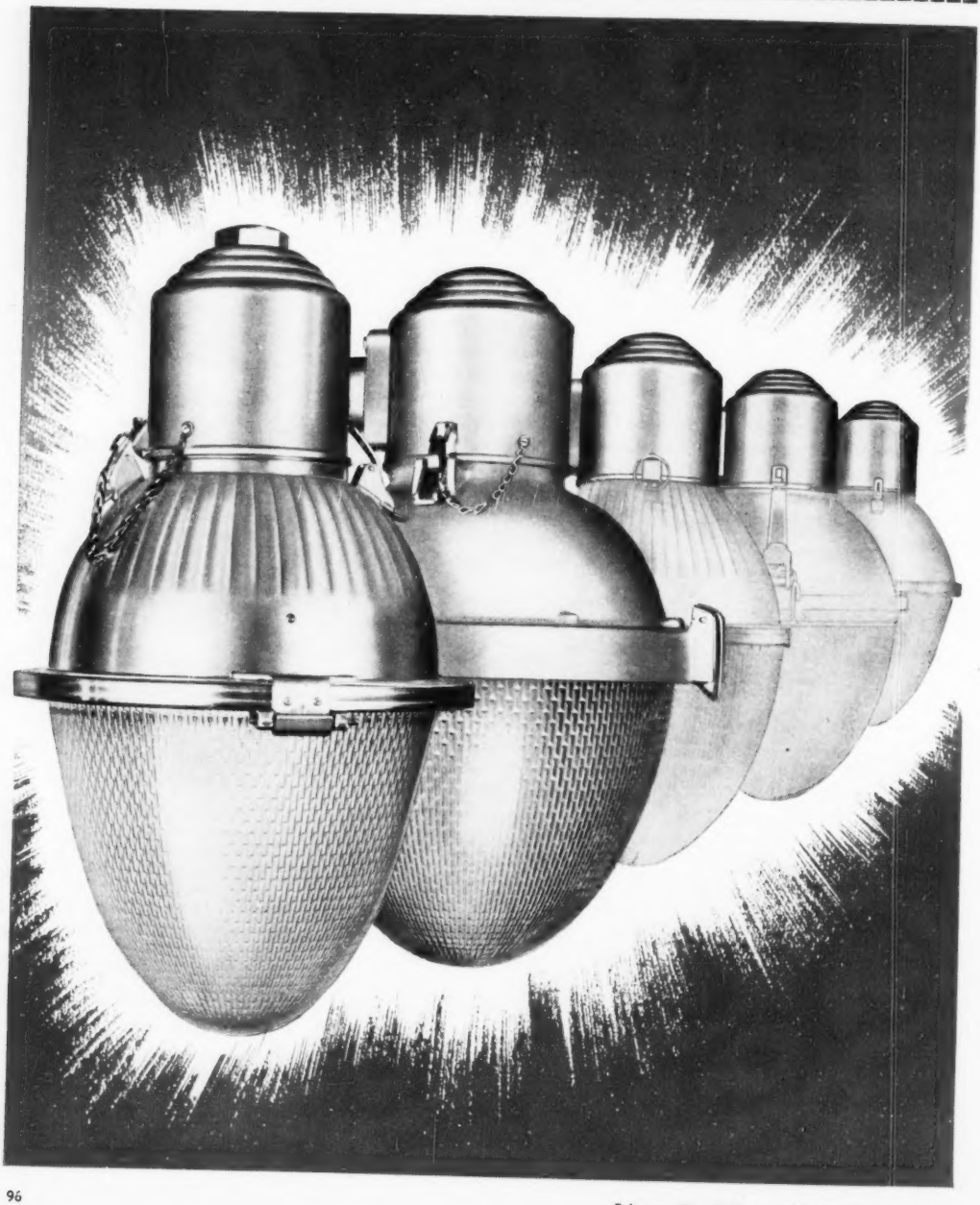
Distributed by
LINE MATERIAL COMPANY
Milwaukee, Wisconsin

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, N. Y.

LM

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



NOW...

Interchangeable Luminaires

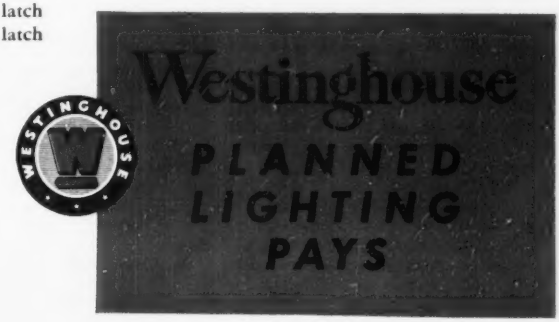
STANDARDIZED WITHIN THE INDUSTRY

New Westinghouse Type AK-10 and AK-14 "Latch-On" street lighting luminaires now are interchangeable *at the head,* with all similar units, by other manufacturers meeting proposed EEI-NEMA standards. Get complete interchangeability—complete standardization—PLUS the advantage of these Westinghouse features:

- **Larger unit—more radiating surface—cooler operation!**
- **Heavy-gauge (.064) Alclad Aluminum Reflector**—for greater mechanical strength—more durable reflecting surface.
- **Fully-automatic latch!** Locks automatically when globe is pushed to closed position. Hinge has stainless steel leaf spring which applies lift pressure for tight fit between globe and reflector.
- **Latch springs of stainless strip steel** assure permanent latching action. Aluminum latch levers with large gripping area make latch operation easy.
- **Lugs in the one-piece, cast-aluminum globe ring "index" the refractors.** Maintenance men can't go wrong.
- **The AK-10 meets all I.E.S.-A.S.A. distribution patterns and industry standards.**
- **The AK-14 is the first, and only, heavy-duty unit designed specifically to meet industry standards.**
- **Aluminum heads** for series or multiple circuits, inner or outer wiring, tap or side mounting.
- **Truly universal luminaires for system standardization.**

Call your nearby Westinghouse office—or write for B-4237, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-04213



Rules for Checking Electrical Drawings

All drawings leaving an engineering office must represent a true idea of the design and adhere to a high standard of workmanship. It is the important function of checkers to detect and correct all defects on finished drawings before they are delivered for construction purposes. Following rules and procedure provide checkers with a systematic approach to their job and aid in training new men for checker's work

WALTER J. PRISE
Supervisor, Electrical Dept
Design Service Co
New York, N. Y.

1. Good checking is a good screening. Approach your problem in a systematic and methodical manner, and go through your job step by step, gradually covering the whole subject.

2. Be sure to obtain not only the drawing you are checking, but all information pertaining to it, such as bill of material, cable and conduit list, as well as all reference material such as engineering and purchasing specifications, mechanical, structural, electrical and manufacturers' drawings pertaining to the project, also rulings and intructions together with file correspondence on the subject. If any information needed is not available, request it immediately.

3. Be sure that you are working on the latest available alteration of all existing drawings and other sources of information.

4. See that you have a clear conception of ideas involved in the design before you start checking. Talk with the Supervisor and Squad Leader in order to obtain such information.

5. Single-line diagrams and various auxiliary diagrams represent the general picture of the design. See that they agree with one another, and with each phase of the job on which you are working, for connections, size of cables and conduits, etc.

6. Each drawing must be checked against its bill of material and vice versa.

7. Be sure that each alteration and addition on the bill of material is incorporated on the drawing, and vice versa.

8. See that all necessary reference drawings are included in list of reference drawings, and be sure that titles of such drawings agree with drawing numbers.

9. Check spelling.

10. Check quantity of all items, and see that they are given in proper units.

11. All items on bill of material must be given under proper classification represented by a proper letter or designation.

12. In ordering material, see that a complete description is given which is non-conflicting. This will enable the purchasing agent to complete the purchase.

13. Check all abbreviations, but remember that if possible all words must be spelled out. Use only standard acceptable abbreviations in accordance with good established engineering, or special client, standards. The client's standard must have preference in conflicting cases. If lack of space makes abbreviations necessary, they must be consistent and uniform throughout each drawing and, if possible, throughout the project.

14. Check all dimensions and locations of everything on a drawing.

15. Check for interference from equipment of other departments.

16. See that all clearances are standard, and that equipment can be installed so it will be readily accessible and removable for repairs and maintenance. Check for working clearances around each piece of apparatus.

17. Make any suggestions that may lead to improvement of design, but do not try to re-design accepted design.

18. Be sure that material, of which items are made, is designated on the bill of material, (as in the case of bolts, conduits, etc.), and that they are the types and sizes anticipated for purchase and in general available on the existing market.

19. See that all small items, such as foot and inch marks, arrowheads, etc., are given on the drawing. Remember that small omissions may be an indication of major and hidden faults in the design.

20. Check all conduit numbers and work against cable and conduit list. Check sizes of conduits. Check cables in each conduit for occupied area. Be sure that cables can be pulled through; more than three 90-deg bends make pulling prohibitive.

21. Consider drainage problem.

22. Check for uniformity of lettering. Remember that in most cases standard sizes of letters have to be adhered to and must be uniform for one drawing.

23. See that each plan is properly connected by reference with another, and is continuation of another when so stated.

24. Check to determine if thermal expansion was considered.

25. See that instructions given by set of notes are conclusive, cover all important phases of work, and can be easily understood.

26. Make all suggestions leading to improvement of workmanship, and check with a good text book on any questions pertaining to general drafting.

27. Mark all lines and items on check prints in red if o.k., in yellow if incorrect, or other definite color scheme.

28. Keep set of notes with each check print and file with other material on project.

29. Checkers are directly responsible to their supervisors, and must consult and report to them during their checking assignments. Check print and set of notes must be turned over to the supervisor after completion of checking job.

30. Remember that after the checker signs his name the drawing is delivered to the client and is open for his criticism. The checker is the last line of defense, and he must, therefore, realize the importance of his work and use the utmost care.

31. Try to improve the drawings. Do not be afraid of going too far into checking, or of offending others. Aim at perfection. Check and double check.

32. *Do not take anything for granted.*

HI-TENSION NEWS *Junior*

AGAIN...O-B is the choice after nearly 30 years of service experience!

● Serving 135 communities, totaling over one and a half million residents, this large metropolitan system has records extending back some 30 years, to which it may refer in making a choice of insulators for new construction. These private records, written in that company's own terms, are a far better guide than all the manufacturers' claims that could ever be collected.

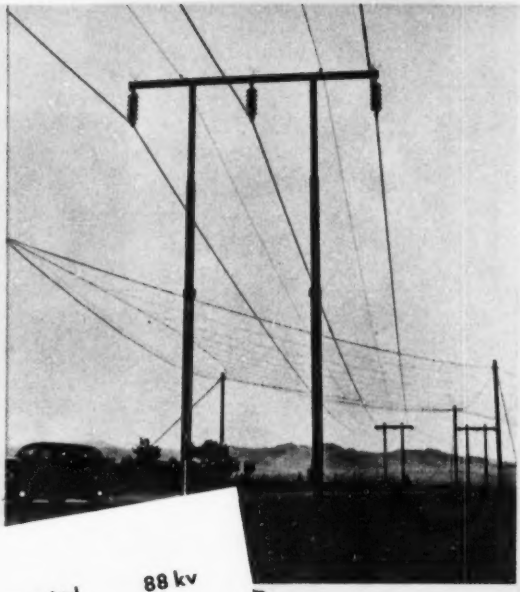
And what do they show? The answer is found in the simple fact that these are O-B suspension insulators going up on this new line—just as O-B's have been installed on the major lines of this system for the past three decades.

When it comes down to a plain story of performance, every well kept record will show the long time durability of O-B suspension insulators. For the best and the longest service, make O-B your choice.

Ohio Brass

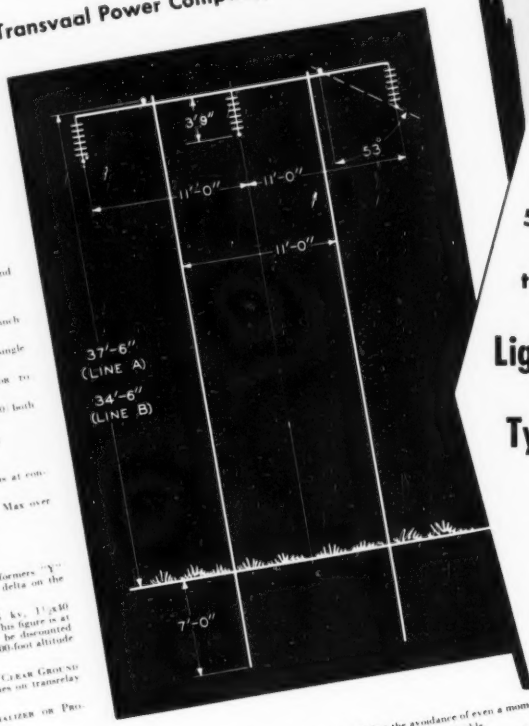
MANSFIELD, OHIO, U.S.A.

HI-TENSION NEWS Junior



Similar Sections of All-Steel H-Frame Line Show Striking Contrast in Lightning Resistance

The Victoria Falls and Transvaal Power Company, Ltd. — 88 kv



Location of Line: South Africa
(A) Klip Station to Princess West
(B) Vereeniging to Vlakfontein West

Voltage: 88 kv

Length
(A) 40.7 miles
(B) 44.7 miles

Years of Operation
(A) 8½
(B) 14½

General Direction
(A) Southeast-Northwest
(B) Southwest-Northeast

Average Terrain: Undulating grass land and rocky. Altitude 6,000 feet

Annual Storm Days: 114

Conductor: 19/.116-0.2 square inch copper

Overhead Ground Wire: Two, single 0.252 solid steel

Mid-Span Separation, Conductor to Ground Wire: 6½ feet

Suspension Insulators: Six 5 x 10 inch tangent and deadend

Normal Tangent Span Length
(A) 570 feet
(B) 520 feet

Arcing Horns or Rings: Horns at conductor

Tower Footing Resistance: Max over 300 ohms, min 1 ohm, avg
(A) 120 ohms
(B) 30 ohms

Counterpoise: None

Type of System: All transformers "Y" connected on 80 kv side, delta on the other side

Impulse Insulation: 565 kv, 1/.540 mu-s, positive critical. (This figure is at sea-level value and may be discounted slightly in view of the 6000-foot altitude of the line.)

Normal Total Time to Clear Ground Fault: 0.3 Second Lines on transrelay protection

Ground Fault Neutralizer or Protector Tubes
(A) None
(B) Petersen coils

Arc Damage to Insulators or Conductors: Occasional damage to insulators or conductors, not sufficiently severe to cause an interruption. Frequently, faults cannot be located, as arcing is restricted to the horns only

Average Annual Lightning Outages
(A) 18
(B) 1.3

Average Annual Lightning Outages Per 100 Miles
(A) 44.2
(B) 2.9

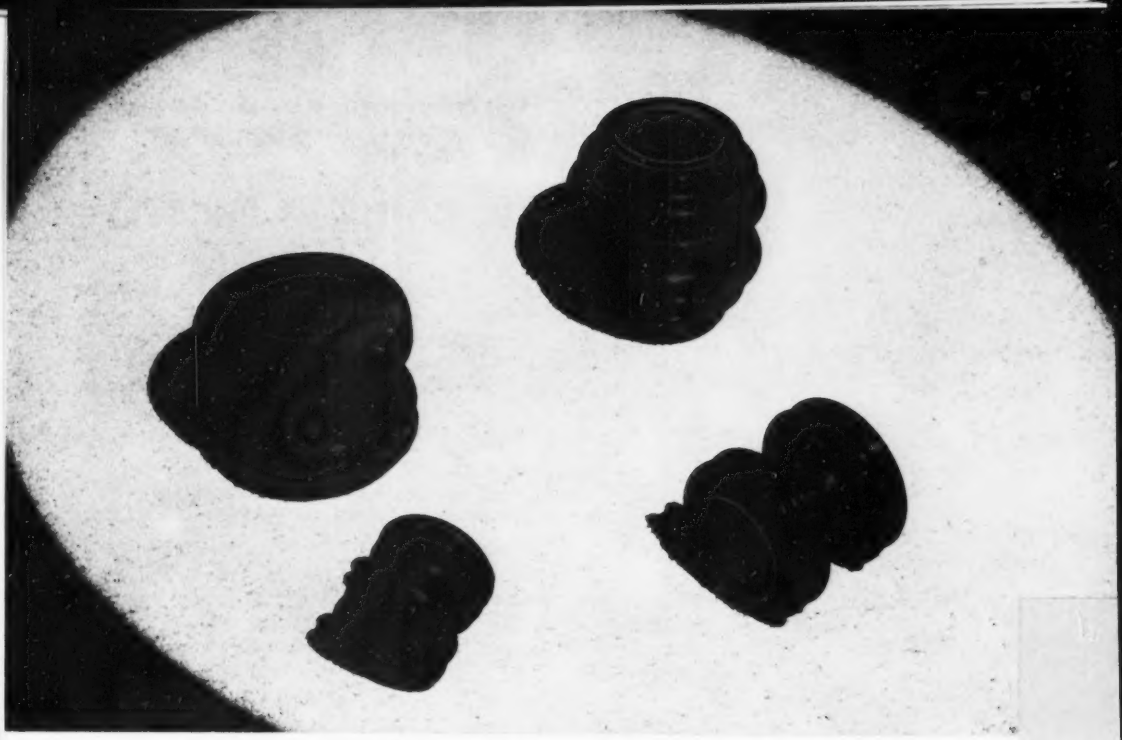
Footnotes: No. 1-Since the two lines covered in this report are very similar in design, length, and operating conditions, the striking difference in lightning behavior is credited to the presence of Petersen coils on Line (B). This protection has not yet been extended to the other line in view of extensive incidental projects that would be involved. Line (B) serves certain power customers whose requirements are such that the avoidance of even a momentary interruption is desirable.

No. 2-The tangent structure photograph shows groups of wire "bristles" over each insulator string. These are used to keep birds off this portion of the structure, since the occurrence of flashovers due to the accumulation of bird droppings on insulators has, in the past, been a troublesome condition.

This is one of 54 reports published in O-B's new technical publication

Lightning Performance of Typical Transmission Lines

copies of which are available on request



Save one-third

plus a dividend of Safety

. . . on small porcelain insulating spools

● Size for size, you pay no price premium for fine O-B wet ware porcelain spools. But, while price is on a par with the more common type of spool, the two materials are vastly different—a difference that amounts to a real saving.

Wet ware porcelain spools have twice the mechanical and dielectric strength of ordinary types. In addition, wet ware will not absorb moisture and thus become conductive and dangerous. With this two-for-one technical advantage, it is possible to substitute a two-inch O-B wet ware spool for a common three-inch size and still actually gain from a safety standpoint. Hardware is slightly lighter and proportionately cheaper. The total saving will be in the order of one-third.

In view of the thousands of spools used each year by the average power company, this saving is worth going after, especially when nothing must be sacrificed to get it.

Consider the possible economies of O-B wet ware porcelain insulating spools seriously. They are now available for prompt shipment either direct from O-B or from your local branch of Graybar Electric Company. Switch to this money-saving practice and get a dividend of safety.

Ohio Brass

MANSFIELD, OHIO, U.S.A.

Here is one good reason why you can *Rely on* O-B MULTIPART PINTYPES

● Each separate component of every O-B multipart pintype insulator receives three minutes of sustained 60-cycle flashover before parts are assembled into a completed insulator. The severity of such a test cannot be duplicated in service because of the electrical grading effect when parts are combined. When an O-B insulator shell passes this test, its soundness is assured. This is one reason for the reliability of all O-B multipart pintypes.

But care doesn't stop here. During and after assembly, each insulator receives many careful, unhurried visual inspections. Then, the completed insulator again is subjected to flashover at 60 cycles as a final proof test.

You can't discover all this fine manufacturing technique by casual examination of an insulator. It would be easy to take short-cuts, and you would be none the wiser—until time and operating demands did the "testing" that might far better have been done by the manufacturer.

But, when you specify O-B multipart pintypes, you have the satisfaction of knowing they have passed the toughest tests and inspections that can be given an insulator. This helps account for the phenominal service life of O-B multipart pintypes. Take advantage of this by specifying O-B multiparts on your major pintype construction.

HI-TENSION NEWS *Junior*

Ohio Brass

MANSFIELD, OHIO, U.S.A.

2970-H

One of two new "pan test" rooms in the modernized O-B insulator plant where all insulator components are subjected to a three-minute continuous flashover. Elaborate ventilating equipment dispels the rich ozone produced, and copper shielding prevents radio interference. Insulator shells that "graduate" from here can be relied on for electrical soundness.

Reinforcing Technique Repairs Damaged ASCR Cable

E. M. WRIGHT
E. G. LAMBERT

Hydroelectric and Transmission Engineering
Pacific Gas and Electric Co
San Francisco

To REPAIR a long-span conductor damaged near the tower, Pacific Gas and Electric Co recently used two reinforcing cables clamped to the conductor and anchored at the insulator. The same method is being considered for use on the remaining conductors of the span for easier inspection and added damping.

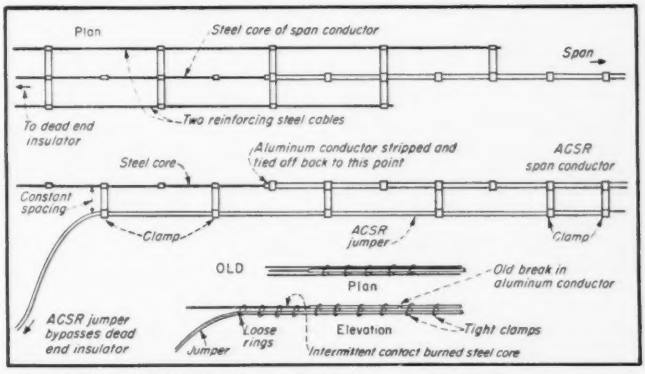
Discovery of a loose clamp at the outer end of the reinforcing assembly revealed serious damage to the ACSR conductor. All aluminum strands had been severed and were loose, leaving the steel core to carry full current. The steel core had been burned in two places where current passed from it back into the adjacent ACSR jumper. Net result was reduction of ultimate strength from 40,000 lb to an estimated 20,000 lb for a conductor with a maximum working load of 18,000 lb.

To reinforce the break, a pair of steel wires identical to the steel core of the main cable were used. They were clamped to the steel core of the main cable from which the aluminum had been removed. A standard guy clamp was adapted with special filler pieces for holding and spacing the three steel cables. By spacing the clamps for non-uniform weight distribution and making the reinforcing cables two different lengths, the installation serves also as an effective damping device (ELECTRICAL WORLD Feb 14, 1948, page 114).

The current carrying ACSR jumper was attached to the main ACSR cable beyond the end of the reinforcing cables with quarter sections of standard parallel groove clamps. It was attached in the same manner to the steel core of the main cable at several points within the length of the steel reinforcing cables to augment the damping effect.

First step in the repair was to take the strain off the main conductors with large turnbuckles and standard grips attached beyond the break. This accomplished the double purpose of allowing the men to work in safety

DAMAGED ACSR CONDUCTOR at Pacific Gas and Electric Co tower repaired by reinforcing with two steel cables extending beyond the break. Standard guy clamps adapted with special filler pieces hold and space cables. Unit serves as effective damping device



REINFORCING ASSEMBLY. New method uses clamps to carry all current to jumper; non-uniform spacing of clamps and unequal cable lengths provide damping. Old method used ring supports, which allowed jumper to make random contact with conductor

6 Ways to Look

IMPORTANT DETAILS MAKE THE DIFFERENCE IN ALLIS-CHALMERS UNIT SUBS

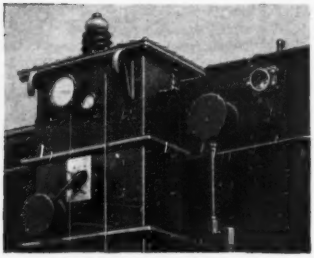
MANY DETAIL IMPROVEMENTS in unit substations have been pioneered by Allis-Chalmers: controlled gasket compression, protective *Oil-Sealed* inert gas system, "quick-break" contact separation, finger-type disconnects, no-corona taped bus joints, flexible drop collar throat, and others.

Together such improvements make up the real difference between superior and average performance. They are good points to look for, and compare, when purchasing unit substations for your distribution system.

±10% Regulation Results in Added Savings

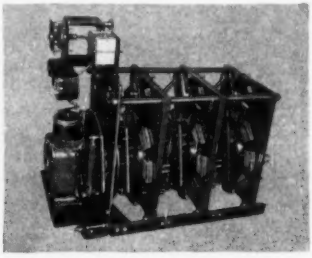
Allis-Chalmers unit substations cost less because of standardization on one range. This reduces your cost because the savings in engineering and manufacturing have been passed along to you. ±10% range was chosen since it fits most utility requirements and permits more load than ±7½%.

Call in your nearby A-C representative and have him go over the advantages you get with Allis-Chalmers unit substations. Or write direct.



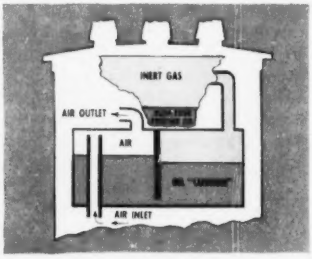
1. SAFETY

NO-LOAD TAP CHANGER on side of tank protects operator from accidental contact with overhead high voltage lines. Other safety features include: dead-front panels; interlocks; vertical lift breakers; drawout potential and control power transformers. Protects your operators, your equipment and your service.



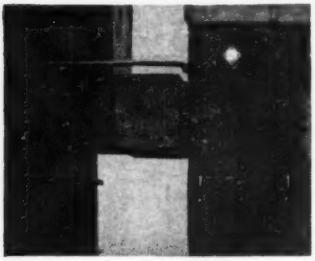
2. REGULATION

±10% RANGE is adequate for virtually any distribution substation. The narrow ⅝% steps of the tap-changing mechanism keep voltage fluctuations to a minimum. Oversize contacts and snap action minimize contact burning. Sturdy mechanism and motor operate in oil for maximum life.



3. MAINTENANCE

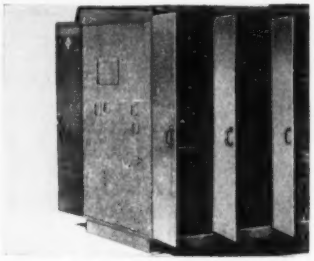
OIL-SEALED inert gas system uses no valves or external gas supply — reduces maintenance to routine gage readings. There are no external gas bottles to replenish, no waste gas. This system operates at pressures usually less than a pound . . . minimizing chance for gas leakage through gasketed joints.



4. INSTALLATION

DROP COLLAR throat saves time and money in preparing foundations. There is no need for exact alignment between transformer and switchgear because flexible connectors are used.

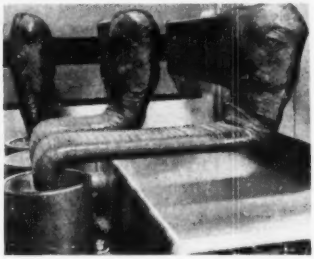
Switchgear units are shipped in groups as large as can be conveniently handled at the installation site.



5. ACCESSIBILITY

SWITCHGEAR HOUSING has doors front and rear permitting easy access to breakers; current, potential and control transformers; fuses.

Feather-Touch control for tap changer is in accessible cabinet. A transparent plastic cover for the voltage integrator permits inspection without breaking dust-tight seal.



6. FLEXIBILITY

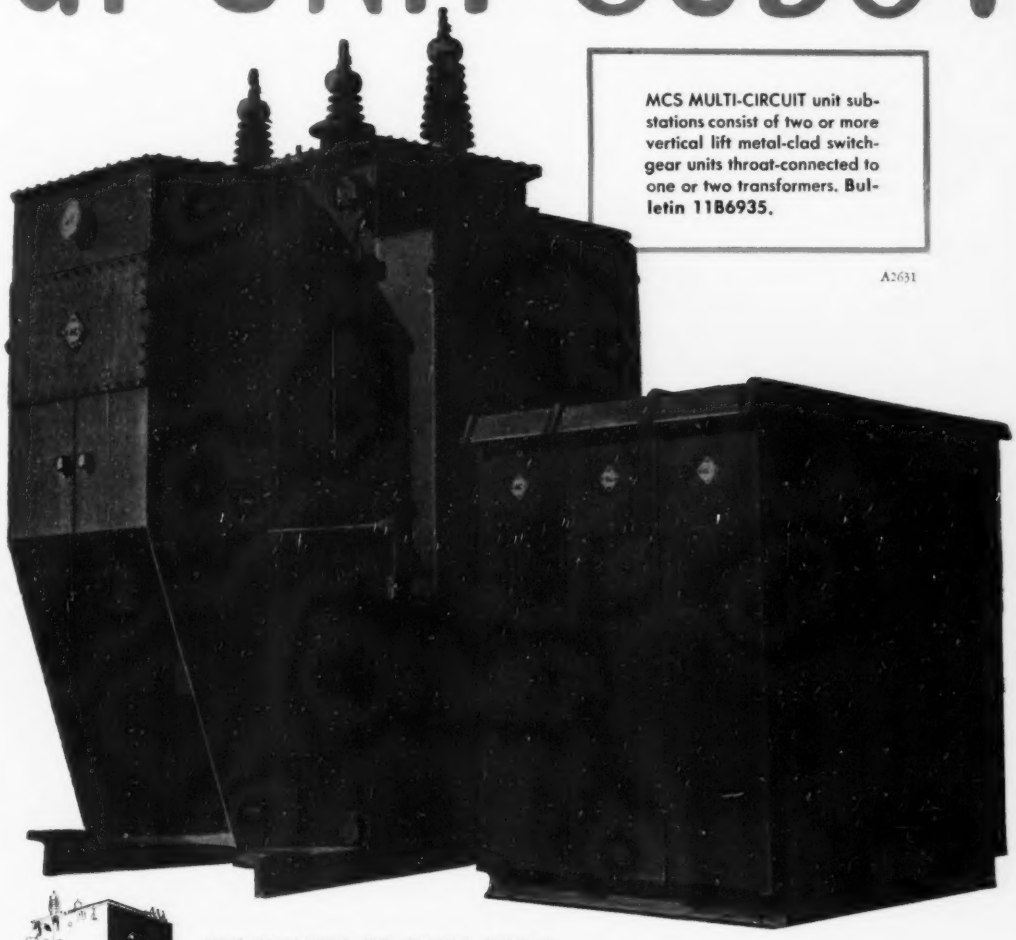
TAPED AND BOLTED connections reduce time and trouble involved in changing connections. No time is lost preparing compound in the field or filling connection boxes.

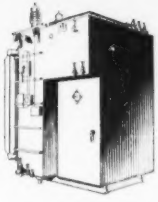
Standardized construction simplifies the addition of new switchgear units when more circuits are needed.

at UNIT SUBS!

MCS MULTI-CIRCUIT unit substations consist of two or more vertical lift metal-clad switchgear units throat-connected to one or two transformers. Bulletin 11B6935.

A2631





ALLIS-CHALMERS SCS SINGLE CIRCUIT unit substations consist of a transformer, secondary breaker and control, *Oil-Sealed* inert gas system for protecting oil, and the 32 5/8% step regulator mechanism for ±10% range of regulation — all combined within a single housing. They can be installed as a unit.

ALLIS-CHALMERS, 932A SO. 70 ST. MILWAUKEE, WIS.

Feather-Touch and *Oil-Sealed* are Allis-Chalmers trademarks

ALLIS-CHALMERS

Pioneers in Load Ratio Control — Originators of 5/8% Step Regulation

portable rectifier power supply

. . . FILTERED AND CLOSELY REGULATED TO WITHIN ± ONE VOLT OF PRE-SET VALUE!

PEC 272! It's a new rectifier equipment designed to provide unusual flexibility of testing power. It's portable . . . built for quick, convenient use when and where you need it. Eliminates necessity of maintaining banks of batteries. Reliable, too. Gives you accurate control of filtered, regulated power . . . holds DC voltage within ± 1 volt of pre-set value, AC r.m.s. ripple under 0.15 volts. Heavy duty selector switch controls operation from high range of 22-30 volts to low range of 11-15 volts. Potentiometer permits close adjustment within each range. Conservatively rated selenium rectifiers are capable of delivering 50 amperes continuously, up to 200 amperes during momentary overloads for motor starting and similar service. Convection cooled . . . no contacts, no moving parts. Write for full details.

POWER EQUIPMENT *Company*

Specialists in Controlled Rectifiers Since 1935

55 ANTOINETTE STREET / DETROIT 2, MICHIGAN

and put enough slack in the main cable to allow the reinforcing cables to take a good part of the strain.

Before this new design, the jumper had been bound to the conductor for several feet back toward the insulator and also to the two reinforcing cables which extended out beyond the tie, but not as far as the jumper. After that, the jumper was loosely supported in rings, back to the point where it dipped down and away to bypass the insulator assembly. With vibration, the jumper came into random contact with the conductor and the core, giving changing resistance, and resultant burning. In this particular case, where a loosened clamp caused the aluminum conductors to fray and separate at the outer end of the assembly, the condition was aggravated and resulted in severe burning of the core, which carried considerable current beyond the break.

The new scheme eliminates the rings by substituting clamps that hold the jumper a constant distance from the steel core. The same type clamps are used to hold the steel core and the two reinforcing cables. Spacing is non-uniform along the length of the assembly to aid in damping. Thus the clamps carry all the current from the span conductor to the jumper and the intermittent contact is prevented.

Bolometer Detects Faulty Joints

SOME DEGREE of success has been had using a bolometer to disclose overheating of conductor joints in energized lines. Infra-red radiation is focused on a heat-sensitive element which then deflects a microammeter to give a qualitative, if not quantitative, indication of joint temperature relative to conductor temperature.

To avoid parallax errors in sighting and to facilitate reading of the instrument, a sighting system was designed by means of which the observer will be able to sight along the axis of the parabolic reflector and at the same time observe the output meter.

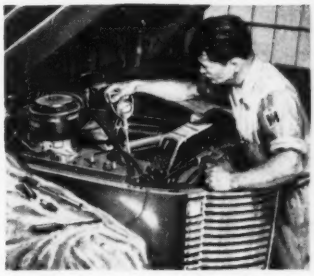
Work on the electrical circuits has consisted of developing a high-gain, low-noise amplifier and a stable oscillator capable of supplying a peak voltage of 100 to 200 v, at 1,000 cy-

Check your truck's heavy winter wear here...

It's been a wearing winter—

Maybe a spring leaf snapped during that severe cold snap. That could cause excessive tire wear, mis-alignment of axles. Or front-end parts may be sprung; that's bad for steering. Brakes may be worn; that's bad for stopping.

But . . . International's specialized spring service is *good* for what ails trucks.



It's been hard under the hood—

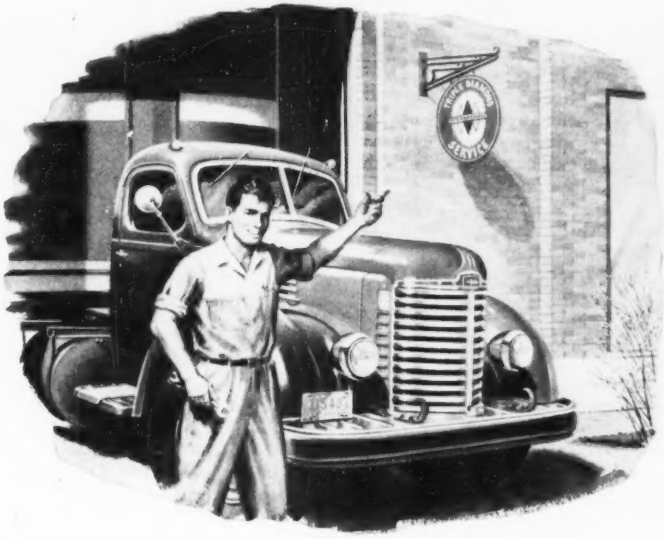
What winter weather took out of your engine, we can put back in!

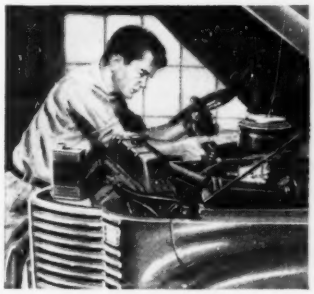
We change oil, inspect, clean, adjust or replace spark plugs, distributor, voltage regulator, carburetor, valves, battery cables, and wiring.

All work is done by International factory-trained mechanics using special equipment.

It's been a tough grind. Here, there and—

Everywhere a truck needs lubrication, it needs lubrication now. So International service experts cover all chassis points, transmission, universal joints, differential, steering gear, wheel bearings, and any other spot that's too dry for its own good. And believe us, they do the job *right!*





It's time to get winter out of your systems—

We'll drain and flush the entire cooling system; refill, adding rust inhibitor, check water pump and cooling connections, check gaskets, hoses, connections and thermostat.

That's how International puts more spring in your truck's systems!

It's overhauling time—for trucks that have been hauling overtime—

4,700 International Dealers, and 170 Company-owned Branches and Service Stations offer you the nation's largest exclusive truck service organization. They're ready with specialized tools and service experience, ready with precision-engineered parts, ready with factory-rebuilt exchange units . . . ready to keep your trucks rolling profitably into spring and summer.

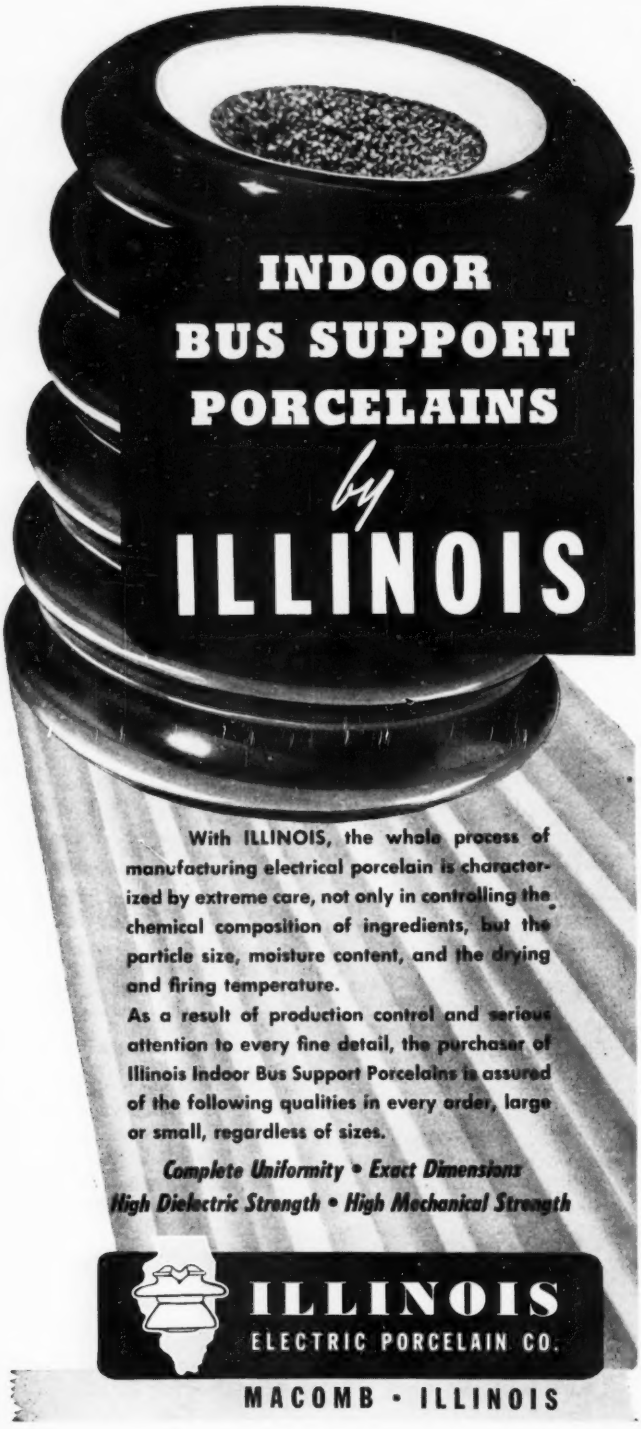
Have your trucks serviced *now* and save money and trouble later!

Other International Harvester Products
Farmall Tractors and Machines
Industrial Power . . . Refrigeration

Tune in James Melton and "Harvest of Stars" CBS, Wednesday evenings

INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY · CHICAGO


INDOOR
BUS SUPPORT
PORCELAINS
by
ILLINOIS
With ILLINOIS, the whole process of manufacturing electrical porcelain is characterized by extreme care, not only in controlling the chemical composition of ingredients, but the particle size, moisture content, and the drying and firing temperature.
As a result of production control and serious attention to every fine detail, the purchaser of Illinois Indoor Bus Support Porcelains is assured of the following qualities in every order, large or small, regardless of sizes.
Complete Uniformity • Exact Dimensions
High Dielectric Strength • High Mechanical Strength
ILLINOIS
ELECTRIC PORCELAIN CO.
MACOMB • ILLINOIS

cles per sec, to the bolometer bridge. The amplifier works into a phase-sensitive detector, operating a 50-μa, zero-center output meter which is observed through the sighting telescope. Sub-miniature tubes are used throughout, and, in order to facilitate servicing in the field, all circuits are constructed in plug-in units. These circuits will be mounted about the top of the nine-inch barrel containing the parabolic mirror, and the batteries will be mounted on the back of the unit behind the mirror. This head, which will be completely self-contained, will be supported on a tripod in such a way that it may be tilted to various vertical angles, and also rotated about the optical axis of the paraboloid in order to line up the long axis of the bolometer strip with the power-line conductor.

As devised by the National Research Council the instrument consists of two thermistor-type heat-sensitive elements connected as the arms of a balanced bridge circuit.

Experimentation by Shawinigan Water & Power Co in collaboration with the National Research Council is continuing because it would be quite an asset to be able to detect defective joints without deenergizing a line.

Reclaiming Oil Justifies Cost

H. C. MARCROFT
Test Department
Pennsylvania Water & Power Co
Lancaster, Pa.

TWO GOOD REASONS can be advanced for reclaiming old transformer oil: (1) Cost is less than half that of new oil, and (2) reclaimed oil is a better cooling agent than new oil.

Tests and experience on the Pennsylvania Water & Power Co system prove that the reclaimed oil will dissolve hardened sludge from the coils of transformers in less than a year. Moreover, the sludge-forming elements of the oil are removed by the reclamation process resulting in long sludge-free life for the reclaimed oil.

The reclamation of oil in quantities of 10,000 to 120,000 gal per year is conveniently done by the use of commercial semi-automatic machines using fuller's earth as the treating agent. Such machines need

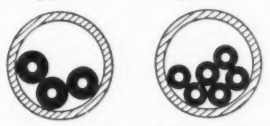
Anaconda continues its "Wire Ahead" Campaign to your industrial customers. They are reading this ad now.

How Big is the CORE of your POWER apple?

Densheath Type TW Building Wire with its special thermoplastic insulation is sound production insurance in any plant. It will not support combustion, is long-aging, impervious to acids, oils and alkalis. It is recognized by the National Electrical Code for circuits up to 600 volts and temperatures up to 140° F. . . . and for wet and oily locations. Being light weight, with a smooth, slick finish and without braid, Densheath pulls through easier . . . resists abrasion. Permanent, bright colors for quick circuit identification. Write for literature.

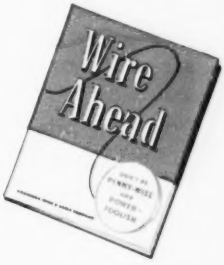
This is important, too—*for rewiring in existing raceways,* the Code recognizes the smaller diameter of Densheath TW and permits more conductors to be pulled in the same size conduit. Here is a typical case—

½" CONDUIT



HOW MUCH of the electric power you pay for do you *throw over your shoulder* through overloaded, overextended, obsolete, inadequate wiring?*

Avoid wasting power. Find present losses and safeguard future expansion. Talk to your plant power engineer, consulting engineer, electrical contractor, wholesaler or utility power salesman. It's their job to advise and protect you against slow-downs and shut-downs that mean unproductive wages, lost production, spoilage.



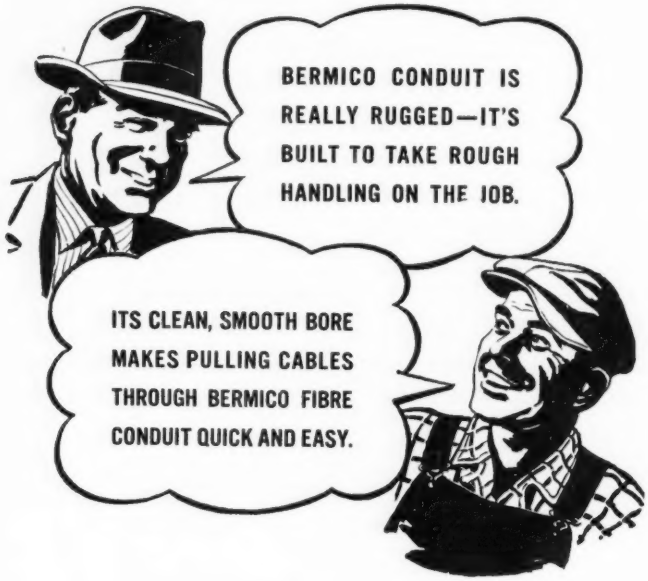
*WIRE AHEAD . . . a comprehensive discussion of preventive maintenance, points out the symptoms of inadequate wiring, presents detailed plans for anticipating electrical demand. Forty-eight factual pages of practical information and suggestions free on request.

ANACONDA

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4, N. Y.

BERMICO* FIBRE CONDUIT


BERMICO CONDUIT IS REALLY RUGGED—IT'S BUILT TO TAKE ROUGH HANDLING ON THE JOB.
ITS CLEAN, SMOOTH BORE MAKES PULLING CABLES THROUGH BERMICO FIBRE CONDUIT QUICK AND EASY.

distributed by
WESTINGHOUSE ELECTRIC SUPPLY COMPANY
Offices in all leading cities

BERMICO FIBRE CONDUIT—A PRODUCT OF BROWN COMPANY

only occasional attention and can be transported to the job, saving oil transportation costs inherent in the central plant oil reclaiming system.

If the old oil is not yet in sludging condition, one or two passes through the earth reclaimer will be the most economical method of reclamation, but if the oil is sludging and tests show a low interfacial tension value (10 to 13 dynes per cm), it will be beneficial to give the oil a chemical treatment previous to the earth treatment, from the point of view of greater economy. This treatment consists of washing the oil with a solution of trisodium phosphate, drawing off the solution after settling, and following with a water wash. A centrifuge will facilitate reclaiming oil from the boundary layer between oil and water in the settling tank, or gravity will do it in several days.

Cost of oil reclamation for a number of large transformers using only the earth reclaimer is given in Table I. Where the combined chemical and earth treatments are used, the costs are shown in Table II. As a result of the treatment by either method, acid neutralization number was cut from 2.0 to 0.05; interfacial tension was increased from 9.5 to 26 dynes; and the saponification number was lowered from 6.0 to 1.0 mg KOH.

Laboratory oxidation tests on reclaimed oil show it to be sludge-free, a non-promoter of corrosion of steel or copper and much more free of acid fumes than new oil.

TABLE I

	Cents Cost per Gal
Original volume of oil, 13,100 gal	....
Earth, activated bentonite	5.62
Filter papers	.90
Purifier Maintenance	2.02
Handling earth	1.41
Draining and refilling transformers	2.52
Moisture removal in centrifuge	1.28
Electric power	.28
Operating labor	1.52
Fixed overhead (reclaimer)	1.69
Total cost, Cents per gallon	17.24
Make-up oil (lost in process) if valued as new oil	4.33

TABLE II

	Cents Cost per Gal
Earth, activated benonite	1.80
Trisodium Phosphate	2.10
Filter papers	.33
Electric Power	.11
Purifier Maintenance	.69
Handling earth	.66
Operating labor	2.52
Fixed charges	1.17
Draining and filling transformers	1.60
Moisture removal in centrifuge	1.28
Total cost, Cents per gallon	11.96
Make-up oil (lost in process) if valued as new oil	2.90

NEW

THE NO. 67 "UNI-MATIC" OIL PURIFIER

for plants purifying 450-550 G.P.H. of lube or fuel oil

The De Laval No. 67 "Uni-Matic" Oil Purifier has a capacity of approximately 450 gph (Navy rating) when purifying turbine lubricating oil. When used to remove contaminants from Diesel lube or fuel oil, its capacity varies from 200 to 550 or more gph, depending on the grade of oil.

Now publicly announced for the first time, the "Uni-Matic" No. 67 has already proved itself on many installations in stationary power plants and in the engine rooms of ships at sea. A single, compact oil purifying unit, complete with pumps and heater, it provides exactly the same advantages common to the other three sizes of "Uni-Matic" Oil Purifiers. That is, it removes ***both*** of the chief contaminants of oil, ***water*** and ***dirt***. It provides complete protection to the turbine or Diesel engines whose bearings it safeguards or, when used on Diesel fuel oil, it makes it possible to obtain the maximum BTU value of the oil.

• Ask for additional details on the No. 67 "Uni-Matic."

De Laval

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

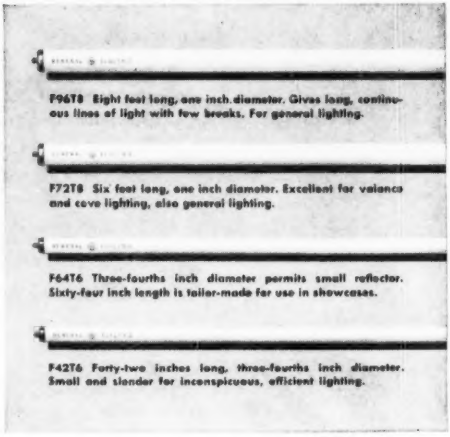
LUBRICATING OIL PURIFIERS

Amazing new G-E slimlines offer you the greatest promotional opportunity in years.

Here's the biggest news in fluorescent since General Electric developed the first practical fluorescent lamp over 10 years ago! G-E slimline fluorescent lamps—world's most advanced source of light—are now available in quantity!

Think of the customers for slimline lighting—stores, offices, factories, schools, restaurants, theaters, showrooms, bowling alleys! Just think of all the new lighting business you can get with this great new product!

Four sizes of General Electric slimline lamps are available for general and special lighting applications. And many new, improved fixtures made especially for G-E slimlines are now on the market. For full information on G-E slimline production, price, application and promotion, contact your G-E lamp office today!


F96T8 Eight feet long, one inch diameter. Gives long, continuous lines of light with few breaks. For general lighting.
F72T8 Six feet long, one inch diameter. Excellent for valance and cove lighting, also general lighting.
F64T6 Three-fourths inch diameter permits small reflector. Sixty-four inch length is tailor-made for use in showcases.
F42T6 Forty-two inches long, three-fourths inch diameter. Small and slender for inconspicuous, efficient lighting.

LATEST ACHIEVEMENT OF THE G-E LAMP RESEARCH THAT HAS

ARE HERE!

Now you can CASH IN on G-E's development of the slimline lamp!

EIGHT BIG NEW SELLING ADVANTAGES

1. MODERN, STREAMLINED APPEARANCE. General Electric slimlines — up to eight feet in length — provide long, continuous lines of light for unique architectural effects.

2. INSTANT START. No starters are used. Just flick the switch for sure, instant starting. Special ballast provides necessary starting voltage.

3. HIGHER EFFICIENCY. Slimlines are the most efficient fluorescent lamps made.

4. EASIER TO INSTALL AND MAINTAIN. Single pin base fits new push-pull type socket. One man can easily install and replace.

5. SIMPLIFIED WIRING. Elimination of starter simplifies wiring, reduces maintenance.

6. THREE BRIGHTNESS LEVELS with one lamp. Operate G-E slimlines at 100, 200, or 300 milliamperes by changing ballasts only.

7. BETTER LIGHT CONTROL. Small diameters permit use of smaller reflector to give better direction of light.

8. LONG LIFE. Although the last published rated life was from 2500 to 6000 hours (depending on frequency of "on" and "off") many users are reporting considerably longer life.

G. E.'s powerful advertising campaign breaks the good news to your customers

News about G-E slimlines is getting big, nationwide coverage with spreads in Time, Newsweek and Business Week, followed by more hard-hitting ads, all reaching *your* customers. Look for these ads (Post, February 19; Time, February 21 and March 21; Business Week, February 12 and March 12)! They mean more slimline sales for you!

Call your General Electric lamp office today and get set for G-E slimline fluorescent lamp business.

G-E LAMPS

GENERAL ELECTRIC

PIONEERED ALMOST EVERY MAJOR DEVELOPMENT IN FLUORESCENT

LOAD BUILDING

TEASER ADS ran in New Orleans newspapers for two weeks

THEN dealer windows unveiled the answer—

Lighting Lagniappe

PRETTY MUCH OBSOLETE these days, lagniappe is a little extra thrown in with the purchase, thirteen to the dozen, suspenders and belt with a suit of clothes. It was pulled out of the past and dusted off for a recent lamp bulb campaign in New Orleans. Buyers of any six bulbs totalling 400 w—that means that at least one had to be larger than 50 w—were given lagniappe in the form of a 150-w bulb. "Lighting Lagniappe" has a seductive selling sound and makes an effective slogan for a campaign.

Cost Meter Featured In Selling Cooking

RITA A. MATARAZA
Home Service Director
Central Hudson Gas & Electric Corp
Poughkeepsie, N. Y.

AN ELECTRIC COOKING cost meter is Central Hudson Gas & Electric Corp's visual way of showing that electric cooking is economical. No longer do women wonder how much it costs to cook a complete meal; instead, as the cooking operations are performed during the demonstration, the cost is being registered before them.

Cost of Service Stressed

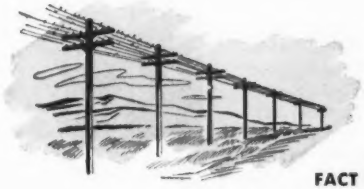
Electric cooking demonstrations, conducted in dealer stores, granges, and other meeting places throughout the Central Hudson's territory, made it evident that the most common misconception among nonusers of electric cooking was "electric cooking is expensive." The home service girls, as they conducted the demonstrations, felt that the homemaker believed electric cooking was clean, cool, fast, convenient and cooked foods perfectly; because the homemakers were actually seeing it done. But the economy feature was intangible. There was no way of actually showing that it cost less than 7¢ a day to cook electrically; and yet the cost of operation was a very important sales point. So a cost meter was developed.

Demand Meter is Utilized

The first step in building the electric cooking cost meter was to find the meter to register usage. The solution to this problem was found in a type 116 MW watthour-demand meter that was tucked away on a shelf in the meter shop (that particular type being obsolete as far as the Company is concerned). This meter was perfect for the purpose; because for every 2 kwhr consumed, the hand made one complete revolution.

Since a kilowatthour is a strange

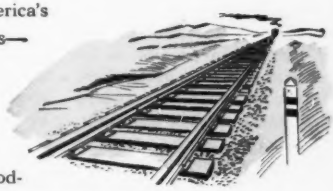
A Few Plain Facts about Preserving Wood



FACT 1: Creosote Oil, properly applied, protects wood against dry-rot, termites, fungi, and other wood destroying organisms—extends the life of wood three to five times, or longer.

FACT 2: Creosote Oil is the most widely used, the most universally preferred, wood preservative in the world.

FACT 3: Creosote Oil for the pressure treatment of wood has been in use long enough to *prove* its effectiveness. It has been successfully used under practically all conditions for more than 100 years.



These are the reasons why Barrett—one of America's oldest and largest producers of wood preservatives—stands squarely behind Creosote Oil. When a truly better, more dependable method of preserving wood is found, you may be sure that Barrett, with more than a half-century of wood-preserving experience, will sponsor it.

These are the reasons, too, why so many of America's leading railroads and utilities continue year after year to use Creosote Oil to protect their huge investments in ties, poles and structural timbers. At today's exceedingly high prices for lumber and labor, they recognize that it's more than ever important to use a wood preservative that has demonstrated its effectiveness beyond all shadow of doubt.

PENETRATES...PRESERVES...PROTECTS

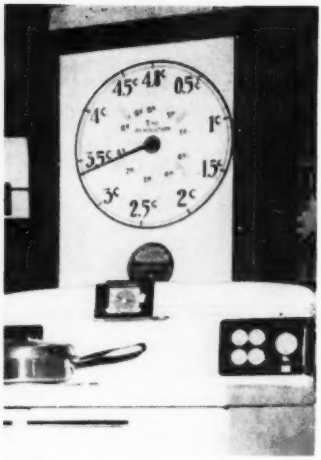
THE BARRETT DIVISION

ALLIED CHEMICAL & DYE CORPORATION

40 Rector Street, New York 6, N. Y.

Barrett®

*Reg. U. S. Pat. Off.



ELECTRIC Cooking Cost Meter provides visual demonstration of cost for a full day's meals—less than 7c a day

term to the average homemaker, it was decided to translate usage into cost in pennies. Consequently, a large clocklike face was built, and on it is marked the cost in pennies as the hand revolved each tenth of the circle. The average cost of electric cooking in our territory is 2.4¢ per kwhr. Thus, the halfway mark shows 2.1¢ and after one complete revolution of the hand, 4.8¢ worth of electricity has been used. An inner circle shows the cost figures for the second revolution of the hand.

The demand meter with its clocklike face was wired, and set up in a rectangular box for ease in transporting and displaying. In cooking demonstrations, meals for a full day were prepared using ordinary foods. The cost for cooking one day's food is shown directly on the dial. Multiplying this cost by 30 gives the monthly cost of cooking electrically.

Two Million Lamps Sold In One-Month Campaign

As a result of an October Lamp Campaign last year, the Electrical Association of Philadelphia reported that 2,058,517 lamps were sold having an aggregate value of $517,317. Prizes totaling $1,642 were awarded to 65 dealers and 40 distributor salesmen.

One of a Series

This campaign, the eleventh in the series, was an intensive drive for lamp sales in the five counties served by the Association. In addition to the manufacturers (General Electric Co, Sylvania Electric Products, Inc and Westinghouse Electric Corp) and the utility, 19 distributors and 738 lamp agents participated in the activity. The activity was similar to that of the lamp campaigns of former years, with prize awards for both lamp agents and distributor salesmen. Awards to lamp agents were $1,020, and to distributor salesmen, $622.

The awards were presented at a dinner by John A. Morrison, managing director of the Association. George E. Whitwell, vice-president, Philadelphia Electric Co congratulated the group on contributing to the advancement of better lighting.

Going to the Lighting Show?

You'll need a ticket to get in. So fill out and mail the form below if you plan to attend the 3rd International Lighting Exposition at the Stevens Hotel in Chicago, March 28-April 1. This will save you the trouble of registering. There is no charge.

The Editor
Electrical World
330 W. 42nd Street
New York 18, N. Y.

Please send me..... tickets for the 3rd International Lighting Exposition to be held in Chicago, March 28—April 1.

Name ..... *Title* .....

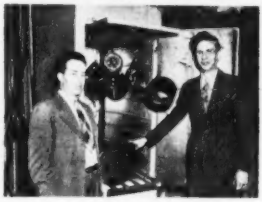
Company .....

Address .....

City & State .....

CONTRACTORS' ITEMS

ELECTRIC OVEN PROVES BUSINESS BUILDER FOR DELAWARE COUNTY CONTRACTOR



IMPORTANT ELEMENT in Philadelphia Electric sales activities is keeping in close touch with electrical contractors. Quarterly publication above is a great help

To Attract Contractors' Interest

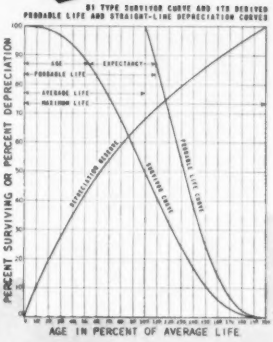
L. R. WEAVER
Philadelphia Electric Co
Philadelphia, Pa.

Electrical contractors in the area served by the Philadelphia Electric Co receive a quarterly reminder of the company's interest in them through the publication *Contractors' Items*. Designed to encourage cooperation between contractors and the utility, the magazine carries stories of contractors' doings and company sales promotions.

Useful Manuals are Described

A feature of each issue is the description of some new manual or other publication, put out by a manufacturer and of particular usefulness to the contractor. Included with each description is a clip-off blank which the interested contractor may mail to the editor of *Contractors' Items*, requesting a copy of the manual. From the 1,000 contractors to whom a recent issue was sent there came 130 such requests, a good ratio of return from any mailing.

Here's help in measuring depreciation the modern way!



The "Survivor Curve" is one of the modern tools used to measure depreciation of plant for tax purposes. Just as a "Mortality Curve" used by actuaries measures man's life expectancy as a basis for life insurance rates, this curve measures the life expectancy of your plant as a basis for depreciation estimates.

EBASCO utilizes these new methods

Using such modern techniques, here's what EBASCO can do for you:

1. Eliminate a large part of the guesswork from your depreciation estimates.

2. Provide you with the *proper* annual depreciation rate.

3. Provide statistical support for such depreciation estimates.

LET EBASCO HELP YOU SOLVE YOUR TAX DEPRECIATION PROBLEMS...

Its recommendations are backed by forty years' consulting experience.

EBASCO SERVICES
INCORPORATED
Two Rector Street
New York 6, N. Y.

ENGINEERS · CONSTRUCTORS
EBASCO
BUSINESS CONSULTANTS

Appraisal · Budget · Business Studies · Consulting Engineering
Design & Construction · Financial · Industrial Relations
Inspection & Expediting · Insurance & Pensions
Purchasing · Rates & Pricing · Research · Sales & Marketing
Systems & Methods · Taxes · Traffic

651

Here's a new handy POCKET CATALOG, Teammate

...planned especially for *you* to save you time and trouble. It's so small... and yet so comprehensive... you can carry it in your pocket when you go to a job and have all information at your fingertips.

This little pocket catalog includes the complete GUTH Line of *precision-planned* Lighting Equipment... every detail you need... all pre-digested into easy-to-find form for instant reference.

Your copy's waiting for you! Just write for Catalog 46A-H.

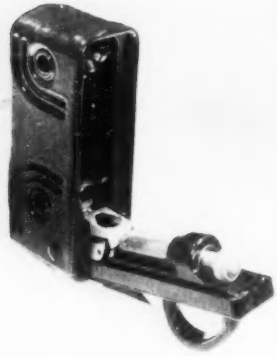
YOUR TEAMMATE IN *precision-planned* LIGHTING

Guth LIGHTING

THE EDWIN F. GUTH COMPANY, ST. LOUIS 3, MISSOURI

Leaders in Lighting Since 1902

NEW EQUIPMENT



Distribution Cutout

To be used where high capacities are required, Type HC cutout, with an interrupting capacity of 8,000 amp at 2.5 kv or 5,000 amp at 5 kv, has been announced by Westinghouse Electric Corp, Box 868, Pittsburgh 30, Pa.

The unit is rated at 5 kv, 50 amp and takes any standard universal-type fuse link up to its capacity. It may be used on 2,400 and 4,800-v delta, 4,160-v wye and 8,300-v grounded wye systems.

Available in dropout or non-dropout models, the high-capacity door may be used to replace doors on standard EA cutouts.

•

Mobile Radio

For operation in existing channels between stations without "spillover" into adjacent channels, 2-way mobile radio equipment is announced by RCA Engineering Products Department, Camden, N. J. The set is designed to operate in the 152-174 mc band.

Known as the Carfone, the transmitter-receiver is housed in a metal-shielded unit only slightly larger than a shoebox. The controls and loudspeaker are combined for attachment under the dashboard.

The manufacturer advises that a newly developed circuit for automatic modulation control locks the voice input level at a constant amptitude. The unit is designed for rugged operations, even over rough and broken roads.

•

Immersion Heaters

Developed for high-pressure, high-temperature applications, Chromalox multiple-element electric immersion heaters have been announced by Edwin L. Wiegand Co, 7513 Thomas Blvd, Pittsburgh, Pa. Capacities of the new heaters, designated as Type TMO, vary from 1 to 100 kw and are obtained by

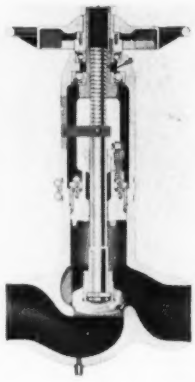
arranging groups of tubular elements in their mounting flanges.

The heating elements, of triangular cross-section, are welded into the heavy forged-steel flanges and are so arranged as to permit the liquid to circulate freely. Units are available in steel, stainless steel or Inconel sheaths as required for various corrosive liquids.

•

High-Pressure Valve

Permitting economical installations by use of smaller valves, a new design for cast steel valves has been developed by Edward Valves, Inc, East Chicago, Inc. Characteristics of the design are



reported to include a decreased pressure loss and a reduction in weight and body size.

Stop and non-return valves in 900, 1,500 and 2,500-lb ASA classes, in either the globe or angle design, use the body for all sizes 6 in. and above. They are available with pressure-seal or bolted bonnet and with flanged or welded ends.

•

Portable Soldering Unit

For soldering small motors, switchboards and other electrical equipment, a light duty, 450-w Thermo-Grip soldering tool has been announced by Ideal Industries, Inc, Sycamore, Ill. Operating on the resistance-heating principle, the tool is ideal for use in inaccessible places and inflammable surroundings, according to the company.

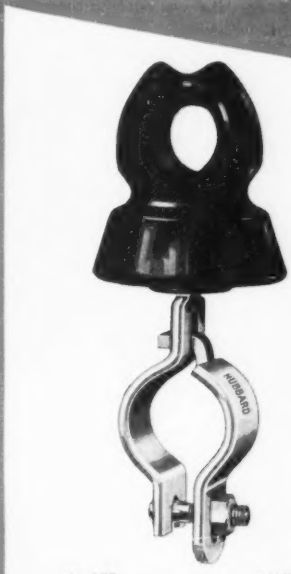
The power unit and case measures $9\frac{1}{2}$ x 6 x $8\frac{3}{4}$ in. and weighs 16 lb. Soldering heats at 5.3 and 4.2 v are available in each unit. All leads and attachments are fully insulated and electrodes are replaceable.

•

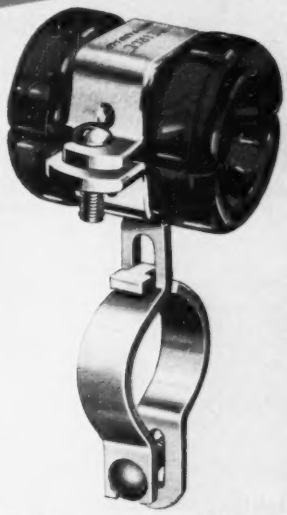
Expanded Scale Voltmeter

Designed for general switchboard use in utilities and large industries, an indicating voltmeter with an expanded scale has been announced by General Electric Co's Meter and Instrument Division, Schenectady 5, N. Y.

The scale, 7.1 in. long and spanning 250 deg about the center, is expanded



No. 180.....1¼" Pipe
No. 181.....2" Pipe
Closed Insulator

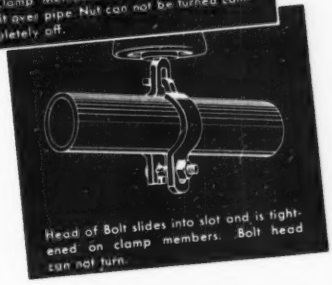


No. 157.....1¼" Pipe
No. 158.....2" Pipe
Open Insulator

Labor Saving—

HUBBARD ONE BOLT TYPE LAMP LEAD BRACKETS

Clamp Members swing apart freely to fit over pipe. Nut can not be turned completely off.



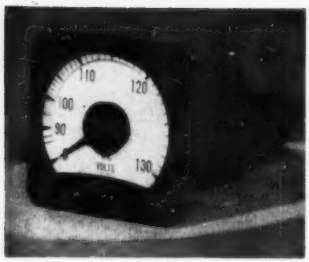
Head of Bolt slides into slot and is tightened on clamp members. Bolt head can not turn.

Hubbard Research and Development Engineers have, by their own volition, established a sort of "Sword of Damocles," which they like to imagine is hanging over their heads, and which bears the related admonitions—"Greater Efficiency!"—"Fewer Parts!"

Consequently, they strive to follow these directions in every new design which they conceive, and are constantly reviewing old products to improve, if possible, their original thinking. The Lamp Lead Brackets illustrated above are but one of many items which have kept the sword from dropping. "Greater Efficiency" and "Fewer Parts"—Both characteristics have been built into Numbers 180, 181, 157 and 158.

HUBBARD AND COMPANY

PITTSBURGH CHICAGO **OAKLAND, CALIF.**



over the most frequently used range, from 90 to 130 v. Detection and measurement of 0.5-v variations may be made within that range. Accuracy is claimed to within plus or minus 0.5% in the range of 105 to 125 v and plus or minus 1% over the expanded range.

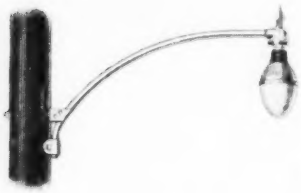
Scales applicable to potential transformers for voltages above rated can be supplied, as well as a black scale with white markings. Bulletin GEC-218A contains further information.

•

Street Lighting Brackets

FOR ADEQUATE street and highway lighting, upsweep type brackets (3-8 ft in length) and mast arms (8-20 ft in length) have been developed by Hubbard & Co, 6301 Butler St, Pittsburgh, 1, Pa. Illustrated is the one-piece type bracket.

Mast arms are available in 1¼-in. pipe; brackets are available in both 1¼ and 2-in. pipe. Designed to be mounted by one man, the brackets are adaptable



for wood, steel or concrete pole installations. The manufacturer states that brackets and mast arms exceed the minimum strength requirements of the joint EEI-NEMA Street Lighting Committee.

•

Flame Failure Safeguard

TO GIVE protection against the hazard of explosion caused by flame failure in industrial oil burner installations, Combustion Control Corp, 77 Broadway, Cambridge 42, Mass., announces a system for supervising both the pilot gas flame and the main oil flame of fully automatic oil burners. The equipment consists of electronic flame rod Type 45JP1, photoelectric scanner Type 45PH5 and programming control Type 24PJ8.

In operation the flame rod "feels" the gas pilot flame. If the pilot flame has not come on or is unsuitable for proper ignition, the flame rod signals this condition to the programming control and the burner shuts down before the main oil valve opens. With proper ignition, the main oil valve opens and the oil flame is then monitored by the scanner control.

Operating from a 115 or 230-v 60-cycle supply, the system is reported to consume 20 w. Bulletin CH4753 contains further specifications and information.

•

All-Purpose Crane

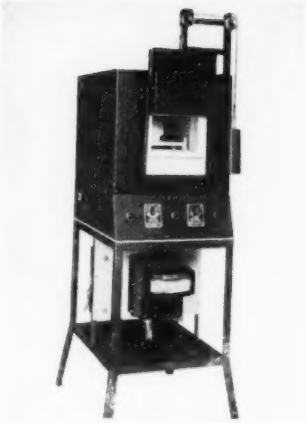
THE ALL-PURPOSE Handi-Crane with a lifting capacity of four tons is being manufactured by Clyde Iron Works, Inc, Duluth, Minn. Mounted on a Minneapolis-Moline tractor, the crane can revolve 320 deg. The operator's seat is offset to provide full visibility. The welded steel boom is raised and lowered by means of a hydraulic cylinder which permits independent boom topping at all times. Circular MP-40 contains complete specifications of this crane.

•

Electric Furnace

PROVIDING heat control over the range from 100 F up to and including 2,000 F, a floor model electric furnace has been introduced by K. H. Huppert Co, 6830 Cottage Grove Ave, Chicago 37, Ill.

This furnace, the No. 11 FM Special, has two sets of heating elements, each set controlled by an Infitrol step-less input controller, with the temperature governed automatically by the third control, a Capacitrol. All controllers are integral parts of the unit. The furnace chamber is 8 in. wide, 6 in. high and 12 in. deep. Overall dimensions are



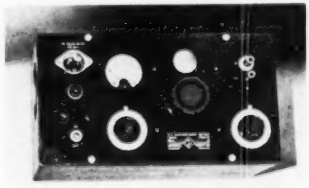
24 in. wide, 29 in. deep and 68 in. high.

Standard operation is preferable on 220 v, single phase, but 110-v single-phase and 220-v 3-phase models are available. Power consumption is reported at four kw.

•

Capacitance Meter

FOR MEASURING and testing small capacitors up to 1,200 $\mu\mu f$, Type 1612-A r-f capacitance meter is announced by General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.



Ranges of 0 to 80 $\mu\mu f$ and 0 to 1,200 $\mu\mu f$ are provided, with automatic range switching as the dial is rotated. Measurements are made at a frequency of 1 mc. The instrument operates on either an a-c or d-c 115-v supply.

•

Motor-Generator Set

FOR OBTAINING five or six currents of different frequencies simultaneously, a motor and generator assembly is manufactured by Kato Engineering Co, Mankato, Minn. Frequencies such as 25, 30, 50 and 60 cycles are available.

The machine illustrated is built for telephone exchanges where five frequencies are necessary to permit selective

First PIONEERED BY PINCO . . . *Now* AN ACCEPTED STANDARD

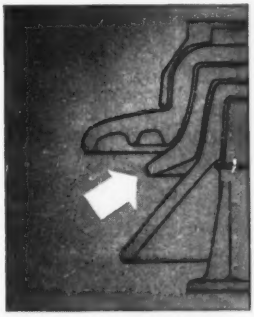
These Pinco No. 735's (in an eastern 115 KV sub-station) were installed 21 years ago . . . and are still *RIGHT* on the job.

THE PINCO NO. 735

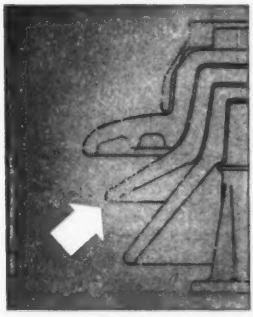
. . . is a better insulator because of: Pinco Porcelain . . . beaded edge petticoats . . . Pinco Resilient Compound, used where metal joins porcelain . . . neat Portland cement used to assemble porcelain parts . . . bearing surfaces of metal parts machined for perfect alignment . . . mounting and clamping holes jig-drilled for accuracy.

SPECIFICATIONS (Per Unit)

Dry Flashover	100 KV
Wet Flashover	95 KV
Leakage Distance	33 in.
Dry Arcing Distance	15 in.
Wet Arcing Distance	9¾ in.
Torsion Strength, inch-lbs.	40,000
Tension Strength, lbs.	20,000



The design Pinco No. 735 made obsolete.



—and how the Pinco No. 735 improved it.

STACKS OF EVIDENCE

. . . that Pinco No. 735's are RIGHT FOR the Job . . . ON the Job!

In 1925, Pinco revolutionized switch and bus insulator design by introducing the 735, with radically different profiling and contouring which greatly increased flashover and leakage protection and reduced the possibility of cascading in stacks.

Pinco 735's have been revolutionizing industry standards of performance and longevity ever since, on installations of all types, and all voltages including 220 KV . . . proving that Pinco design and Pinco manufacturing techniques inevitably combine to solve insulator problems once and for all! So, when you put it up, *put it up to Pinco!*

READY SOON! . . . **A new and different PINCO Catalog is on the way. Reserve your copy today by writing to us or the nearest JOSLYN office.**

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Suspension Insulators . . . Switch and Bus Insulators . . . Distribution Clamps Distribution Pin Types and Guy Strains . . . Transmission Line Fittings . . . Tree Insulators . . . Transformer and Circuit Breaker Bushings . . . One Piece and Multi-part High Voltage Pin Types . . . Suspension and Strain Clamps . . . Indoor Bus Support Porcelain . . . Lightning Arrester Porcelain.

PINCO INSULATORS

North • East • South • West . . . It's Schramm

. . . doing jobs like these in Your Field

At almost every turn you need compressed air!

The check list (at right) indicates some of the many compressed air jobs to be done, all of which are accomplished easily, quickly and economically with Schramm Air Compressors.

Here's *why* you profit, as others have, by using Schramm: they're compact, lightweight, easy to start; built for rugged jobs, to provide a continuous flow of air.

Important features include 100% water cooled; mechanical intake valve; forced feed lubrication and easy, electric push-button starting.

Performance everywhere has proved Schramm Air Compressors can do any compressed air job you require. Write today for list of models and sizes.

- Rock Drilling
- Breaking Pavement
- Trench Digging
- Clay Spading
- Sheet Pile Driving
- Backfill Tamping
- Caulking Pipe Lines
- Spray Painting
- Sand Blasting
- Digging Post Holes
- Pneumatic Grease Guns
- Pneumatic Tools
- Spraying Metal
- Spraying Enamel
- Riveting
- Steel Drilling
- Wood Boring
- Scaling
- Chipping
- Caulking Boilers
- Cleaning Boiler Flues
- Cleaning Engine Generators
- Operating Air Hoists

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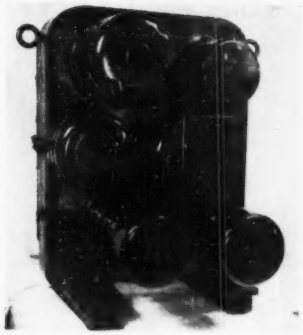
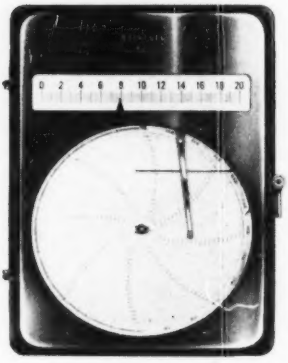


ringing on party lines. Generator capacity is 150 w at each frequency. A synchronous motor drives each generator through a silent chain drive. By proper selection of gear ratios each generator can be made to produce the desired frequency.

•

Time-In-Process Recorder

AN INSTRUMENT for recording time-in-process has been developed by The Bristol Co, Waterbury 91, Conn. This instrument gives a reading on a uniform scale and chart of rate of conveyor movement, directly in terms of total time consumed by work in travelling through a process.



Applications of the recorder include such continuous equipment as furnaces for metal annealing, tempering and hardening, drying and baking ovens and ceramic kilns.

•

Recessed Lighting Fixture

DESIGNED to step up light output and lower surface brightness, a lens-down light is available from Lightolier, Inc, 11 E. 36 St, New York, N. Y. Known

IS YOUR NEW DESIGN HOT IN MORE WAYS THAN ONE?

New designs in radio, television and electrical appliances call for resistance to higher temperatures. . . . And here's just the wire to make connections wherever higher ambient temperatures must be met.

It is Intelin IN-108—product of the Selenium-Intelin Division of Federal Telephone and Radio Corporation. Its insulation, developed by Federal, is based on VINYLITE Brand Plastics.

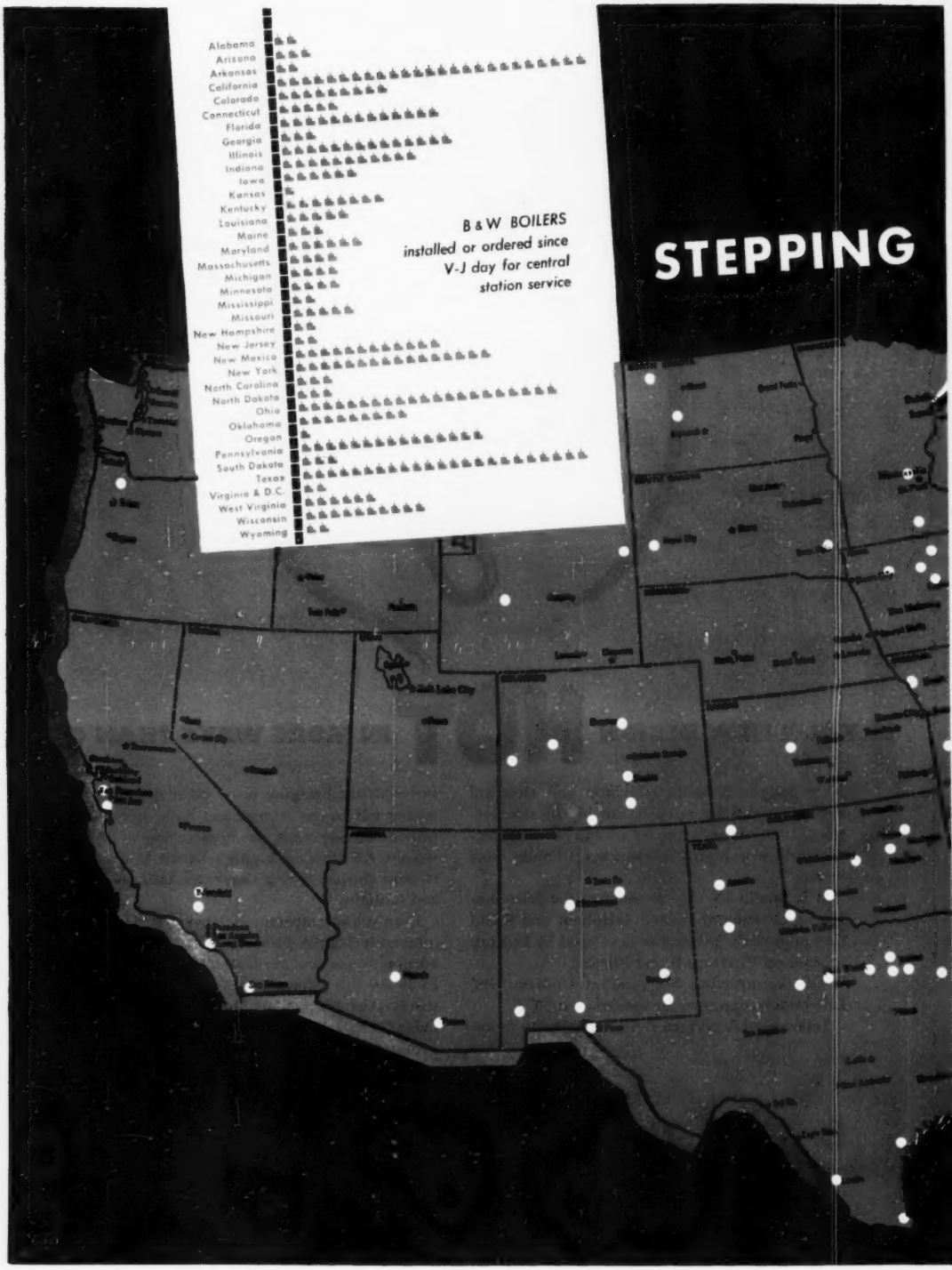
This construction has received Underwriters' Laboratories approval for operation at 90° C.

Economical VINYLITE Brand Plastic insulation materials are bringing many other equally spectacular advantages to wire and cable users. They provide thinner walls, saving space and, of course, weight. All types are highly resistant to abrasion, to most chemicals, to grease, oil, alkalis, moisture and sunlight.

Even at low temperatures, VINYLITE Plastics are inherently flexible. Either non-flammable or slow-burning types are available. Write Department ES-28 for full information. Ask for the informative booklet entitled: "VINYLITE Plastic Wire and Cable Compounds."

Vinylite BRAND **PLASTICS**

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.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B & W BOILERS
installed or ordered since
V-J day for central
station service
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Arizona
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Colorado
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Florida
Georgia
Illinois
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Maryland
Massachusetts
Michigan
Minnesota
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Wisconsin
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UP AMERICA'S POWER

...with B&W STEAM

America's privately-owned power companies aren't letting this nation go power-hungry. They are keeping ahead of its insatiable appetite for kilowatts by providing new steam-electric generating facilities at the greatest rate in history.

For example, dots on this map represent central stations where steam for over 9 million kilowatts of new capacity is being supplied by B&W Boilers either placed in service or ordered since V-J Day. Included in these new units are the largest central station boilers ever designed.

Nation-wide acceptance of B&W Boilers is as old as the central station industry itself. In the future as in the past, power companies can depend upon B&W for boiler designs that will continue to help supply America with adequate, dependable power at the least possible cost.

B&W

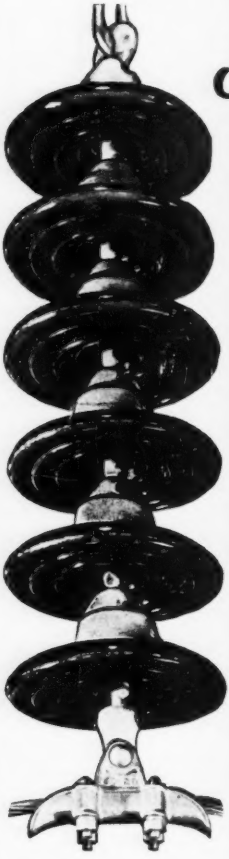
BABCOCK & WILCOX

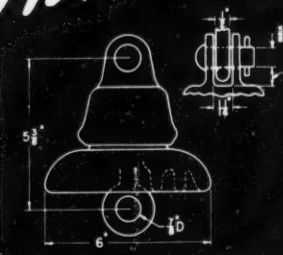
THE BABCOCK & WILCOX CO.

General Offices: 85 Liberty St., New York 6, N. Y. Works: Alliance and Barberton, O.; Augusta, Ga.

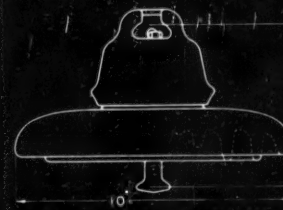
J-D

SUSPENSION and STRAIN Insulators

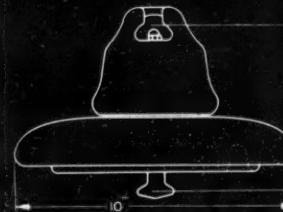




No. 2680 Standard Type M. & E. 10,000 pound



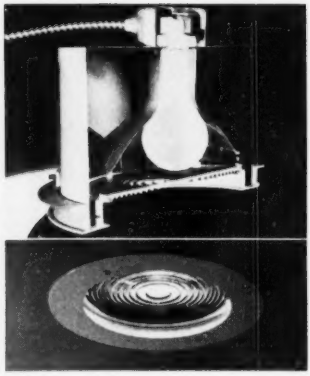
No. 2685 Standard Type M. & E. 15,000 pound



No. 2689 Super Rugged Type M. & E. 15,000 pound

Write for Bulletin No. 201

JEFFERY-DEWITT INSULATOR CORP.
KENOVA, WEST VIRGINIA
U. S. A.



as Calcu-lite, the fixture employs an alumilited reflector and a colouvered lens, the verticals of which are opaqued with colors of either black, coral or white.

The inside lens surface is strippled (pebbled) to increase light dispersion. A cone of useful light of about 45 deg is reported. Available in 4, 6, 9 and 11-in. diam, lens-down lights can accommodate lamps with wattages ranging from 75 to 500 w.

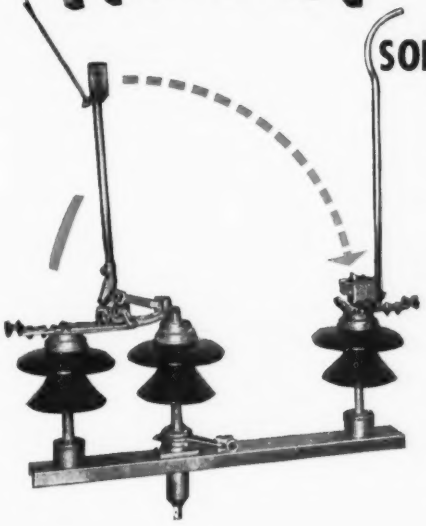
MORE NEW PRODUCTS
about which you should know

Bostwick Laboratories, Bridgeport 5, Conn., have developed a 16-oz handy **fire extinguisher** for hydrocarbon, electrical and paper fires, that is reported to throw a stream of carbon tetrachloride 18 ft. . . . Steber Mfg Co, Maywood, Ill., announces a weatherproof, aluminum **lamp holder** for PAR-38 and R-40 lamps which may be mounted singly or in groups up to five on $1\frac{1}{2}$ or 2-in. pipe and has UL listing. . . . Tilden Tool Mfg Co, 1995 N. Fair Oaks Ave. Pasadena 3, Calif., manufactures a rotary **drill bit** with sintered carbide cutters that is said to penetrate concrete at a rate greater than 2 in. per min in diameters of from $\frac{1}{4}$ to 2 in.

Richmont, Inc. 2810 E. 11th St. Los Angeles 23, Calif., has available a **torque bar** which may be preset for and indicates by sound and touch torque within a range of 200 to 600 ft lb. . . . Automatic Transportation Co, 8 S. Dearborn St, Chicago 3, Ill., is producing an electric **stacker**, the Transider Stacker, on which the driver is seated; which can lift up to 3,000 lb. . . . Induction Heating Corp, 181 Wythe Ave, Brooklyn 11, N. Y., have designed a **gear hardening machine** which is claimed to automatically heat, quench and index gears ranging from 20 in. in

IN-OUT 100,000 TIMES...

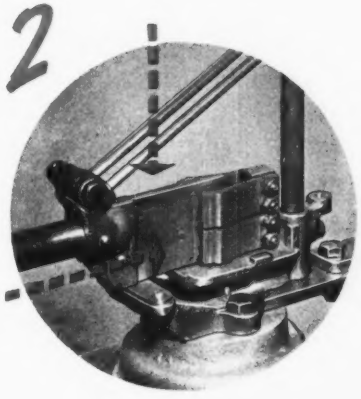
SOLVES YOUR SWITCHING PROBLEMS

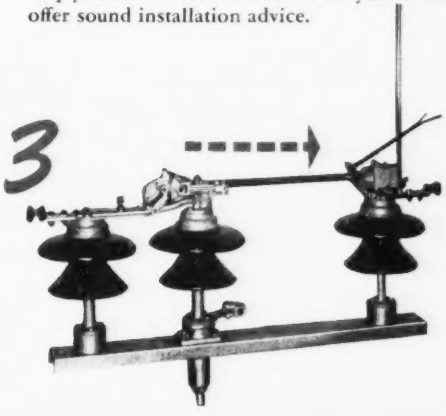


• You're watching the blade and contacts of a Hi-Voltage Switch close . . . firmly, positively and easily. This vertical "in-out" action has made contact life unlimited. Endurance tests in the laboratory . . . thousands upon thousands of switch operations . . . have shown no appreciable wear of Hi-Voltage contacts. We have never received an order for replacement contact parts. They don't wear out . . . they don't overheat . . . they don't need adjustment . . . they don't need cleaning.

The line-type contacts are silver-nickel, welded to copper . . . combine low resistance with low friction. Stainless steel springs maintain maximum conductivity. Operating effort is applied directly to the switch arm. A simple mechanical linkage controls the smooth, powerful motion. The entire switch is engineered to eliminate failure and wear.

Ask your Joslyn salesman to show you more money-saving advantages of Hi-Voltage switches. He will help you select the best switches for your installations, offer sound installation advice.

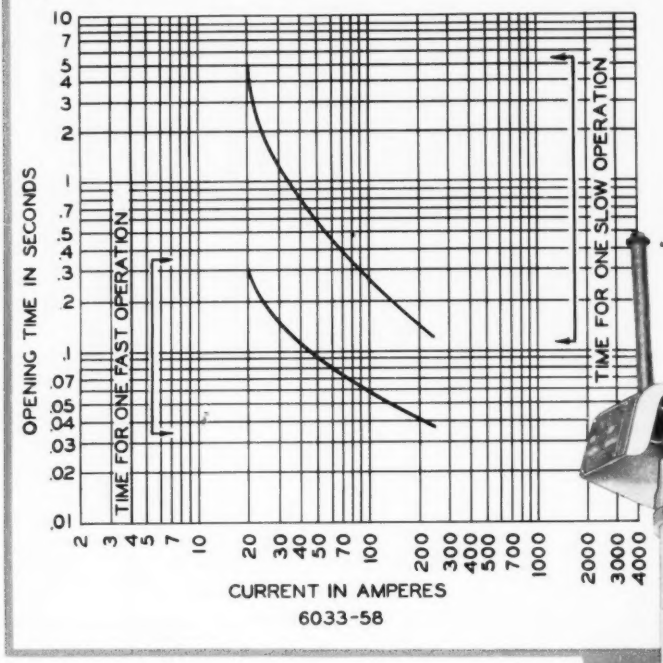


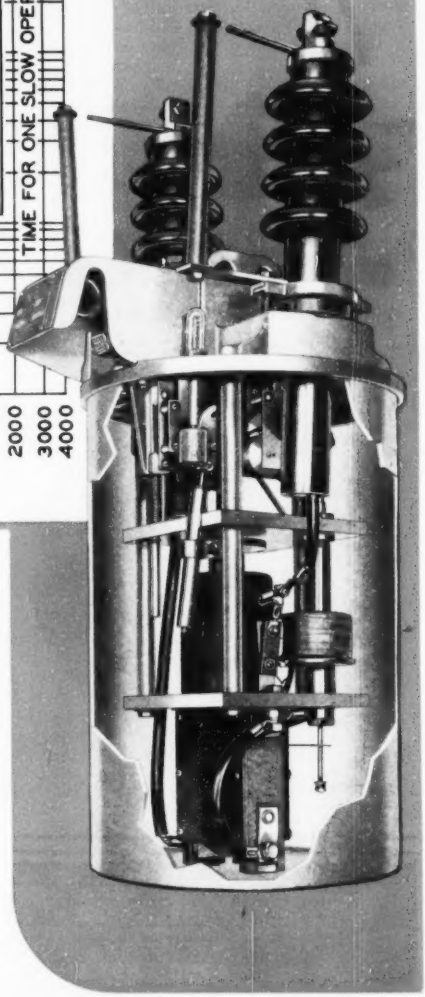


HI-VOLTAGE EQUIPMENT COMPANY

4000 EAST 116TH STREET • CLEVELAND 5, OHIO

New Time Current





Shown above are the operating characteristics of the 10 ampere Kearney OCR. It is typical and the slope is the same for all ratings — 5, 10, 15, 25, 35 and 50 ampere. Operating characteristics charts are available for all Kearney OCR's — simply specify the rating in which you are interested when you make your request.

Characteristics

of the

KEARNEY OCR

Permit Replacement of Any OCR on Your Line

Now you can take advantage of the improvements found only in the Kearney Oil Circuit Recloser.

The larger physical dimensions, greater oil capacity and greater arc quenching ability of the Kearney OCR are your assurance of less maintenance and less frequent oil changes. The new time current characteristics enable you to use the Kearney OCR regardless of the type now on your poles, and thus grade up your service for the increased loads of tomorrow.

At the right are sketches showing the simplicity and varied methods of installation of the Kearney OCR on poles or crossarms.

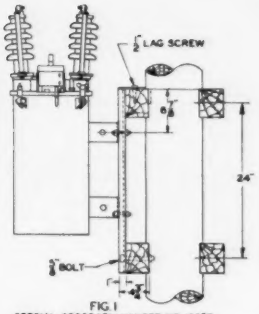


FIG. 1
SPECIAL CROSSARM HANGER NO. 13677

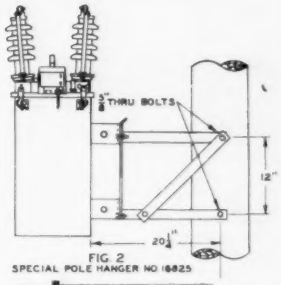


FIG. 2
SPECIAL POLE HANGER NO. 16825

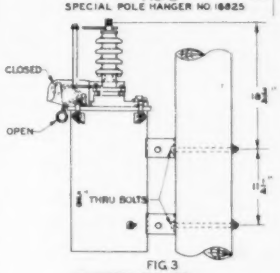


FIG. 3
NO HANGER REQUIRED

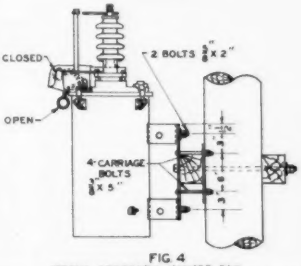


FIG. 4
SPECIAL CROSSARM HANGER FOR SINGLE DOUBLE ARM MOUNTING NO. 17208

FOR BETTER CONSTRUCTION AND MAINTENANCE

Always Specify KEARNEY PRODUCTS *for the Job*

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

4224-42 CLAYTON AVE. – ST. LOUIS 10, MISSOURI

Canadian Plant, Guelph, Ontario

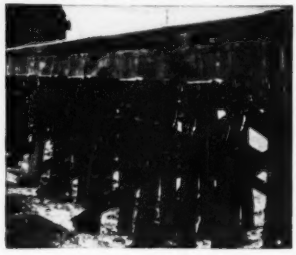
KOPPERS CREOSOTE

-to be sure!

DECKING 14 YEARS This car, with pressure-*creosoted* decking, was sidetracked for its first major repairs after 14 uninterrupted years of service. Usual life of untreated car decking is about 5 years. Not only did pressure-*creosoting* cut maintenance costs; it prolonged the revenue-producing life of the car.

POLES 30 YEARS On the average, Pressure-*Creosoted* Poles have a life expectancy of 30 years. Pressure-*creosoting* offers *proved* performance and dependability.

PILES 30 YEARS Pressure-*Creosoted* Piles give unrivalled protection against decay and marine borers. Many *creosoted* marine piling installations are reported sound and serviceable after more than 30 years of use. Pressure-*creosoting* lowers maintenance costs.



BRIDGES 40 YEARS This is one of several pressure-*creosoted* timber bridges which is still in use after more than 40 years. The resistance of pressure-*creosoted* bridges to decay, year in and year out, assures uninterrupted service and low annual replacement costs.

TIES 25 YEARS Pressure-*creosoting* pays off to railroads. The long life of pressure-*creosoted* ties (25 years isn't unusual) has cut replacement costs $88,500,00 annually.

All Standard Specifications

For All Types of Wood Preservation

KOPPERS CREOSOTE

KOPPERS COMPANY, INC. • Pittsburgh 19, Pa.

diameter, with a 12-in. face or larger with 20-kw equipment.

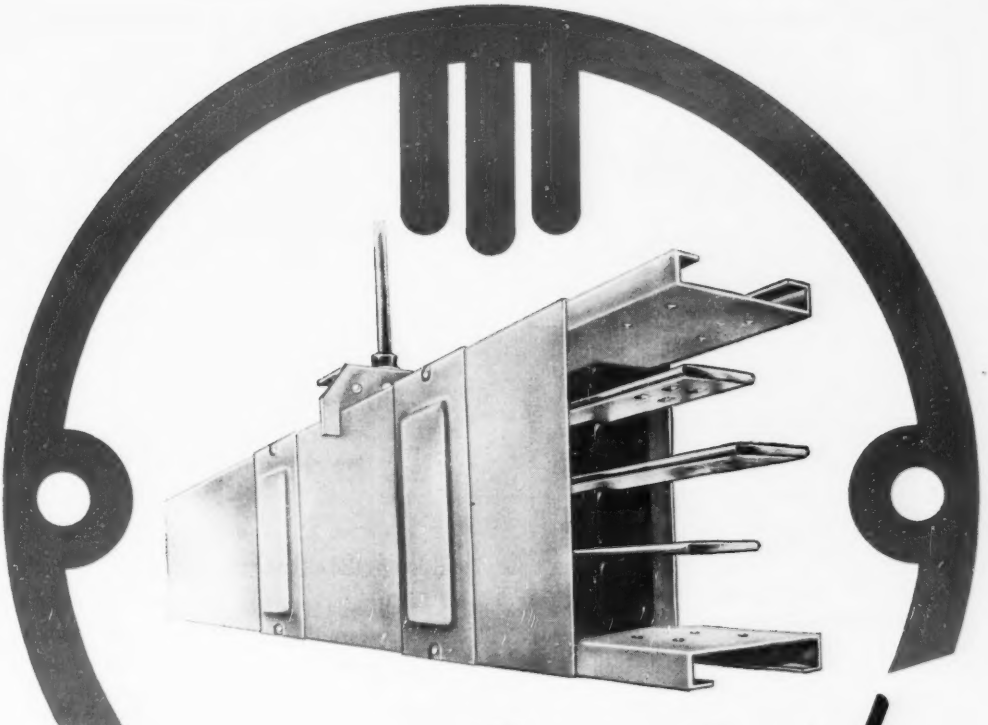
Interstate Mfg Co, Hudson, Mass., have introduced a waterproof **lineman's suit** with Scothlite marking tape to make the wearer at night visible up to 400 ft. . . . . Allegheny Steel Band Co, Carnegie Pa., now produces strip steel **strapping** and **seals,** together with accessories, for use in banding packages, bales, boxes and pallets. . . . American Cyanamid Co, 30 Rockefeller Plaza, New York 20, N. Y., have announced a **demineralizer,** consisting of a disposable cartridge of ion-exchange resins, a cartridge bracket and an electrical conductivity tester, which is reported to deliver the chemical equivalent of distilled water at a rate of 10 gph (max).

Juniata Co, Park Building, Pittsburgh 22, Pa., has available a portable **ladder stage** of aluminum alloy and waterproof wood that affords a working area of 26 x 24 in. . . . . W. L. Maxson Corp, Unimax Switch Division, 460 W. 34th St, New York 1, N. Y., is producing an aluminum-cased, splash-proof **precision switch,** Model KMX, which measures $1\frac{1}{8}$ x $2\frac{1}{4}$ x $\frac{7}{8}$ in. and permits either left or right hand mounting.

Elwell-Parker Electric Co, Cleveland, Ohio, now produces an electric **industrial truck** for tiering loads up to 2,000 lb with a lifting mechanism operated by a low-pressure hydraulic system. . . . Stevens Mfg Co, Mt. Pleasant, Mich., has announced a pipe and **utility rack** for pick-up and panel trucks that folds out of the way when not in use to protect the grille. . . . Eutetic Welding Alloys Corp, New York 13, N. Y., has developed a **welding rod** called Eutectrode 24/49 for work on gray and alloy cast iron; to be used with a-c or d-c power supplies.

General Electric Co, Schenectady 5, N. Y., is manufacturing a **balanced wave system** for Inert-Arc welders that is reported to reduce the duration of radio interference to a fraction of a second. . . . Atlas Sponge Rubber Co, 806 E. 61st St, Los Angeles 1, Calif., has announced industrial sponge **rubber mats** available in black or green 47-in. units for use on concrete or tile floors to reduce leg strain. . . . Compco Corp, 2251 W. St. Paul Ave, Chicago 47, Ill., has a table-model **tester** for fluorescent lamps and starters that indicates whether units are worn out or defective; operates on 110-v, 60-cycle power.

Catho-Lite Co, Inc, 4122 W. Belvedere Ave, Baltimore 15, Md., has designed a cold cathode slimline **lamp,** the 96T8, which features a cloverleaf single pin base, for currents up to 200 ma. . . . Crescent Truck Co, Lebanon, Pa., is now producing electric industrial **fork trucks** equipped with penumatic tires and an automatic self-loading scoop in capacities up to 15 cu ft.



Outlets every foot!

Plus greatest plug-in safety . . .
Federal Noark Bus Duct

FOR PLUG-IN POWER where you want it, when you want it, be sure you get the *extras* that come in industry's "convenience outlets"... Federal Noark Bus Duct. Utmost flexibility...insulated openings for complete safety in applying and removing plug-in devices.

Federal Noark Bus Duct has four-channel strength—sides, top and bottom are all rigid. Rugged bus bar insulators are mounted on 12" centers for high electrical safety and mechanical strength. Adjustable hangers reduce both installation time and cost. Contacts at bolted connections are silverplated.

See your Federal Distributor about Federal Noark Bus Duct. And write us for your copy of Bulletin 180 giving full descriptions and data. Federal Electric Products Company, 50 Paris St., Newark 5, New Jersey.

FEDERAL NOARK
BUS DUCT

Complete line of Federal Electric Products includes Motor Controls, Safety Switches, Service Equipment, Circuit Breakers, Panelboards, Switchboards, Bus Duct ★ Sales offices in principal cities.

NEW UTILITY STATIONS C-E EQUIPPED

Includes stations placed in operation since the war (in white) and those under construction or being engineered.

TIDD
JENNISON
CECIL LYNCH
HAVANA
MEREDOSIA
PERMIAN BASIN
O. H. HUTCHINGS
REX BROWN
HICKLING
B. C. COBB
RUSSELL
SEWAREN
POSSUM POINT

PORT JEFFERSON

CUTLER
GADSDEN
WHITE RIVER
ORAN
ALEXANDRIA
COUGHLIN
WOOD RIVER
JIM HILL
DAN RIVER
W. SPRINGFIELD
DUNKIRK
TITUS
HUTCHINSON
TWIN CITIES
DALLAS
EDGE MOOR
YATES
CONTRA COSTA
LEE
CLERMONT

NEW

A timely addition to the electric generating capacity of the Long Island Lighting Company's system was achieved early in December when the first unit of its Port Jefferson Station went into service.

Ideally situated at the head of Port Jefferson Harbor, this fine new plant will not only provide for the rapidly growing power requirements of eastern Long Island but through transmission connections will make a highly desirable addition to the margin of safety between the system's generating capacity and present peak demand.

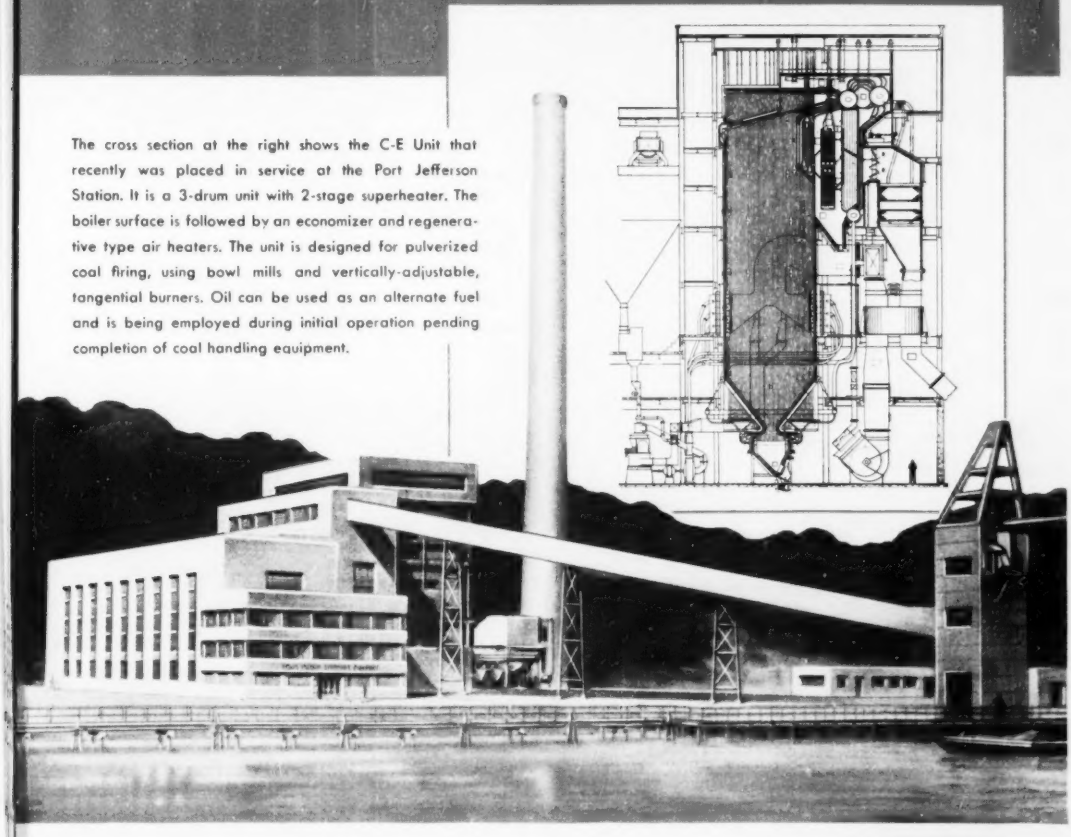
Steam for this new 40,000-kw turbine-generator is supplied by a C-E Steam Generating Unit, sectional elevation of which is shown on the opposite page. Construction work in preparation for the installation of a second 40,000-kw unit—scheduled for service late in 1950—has already begun. This, too, will be served by a C-E Steam Generating Unit. Ebasco Services, Inc., are the consulting engineers. B-296

COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

Port Jefferson Station goes into service

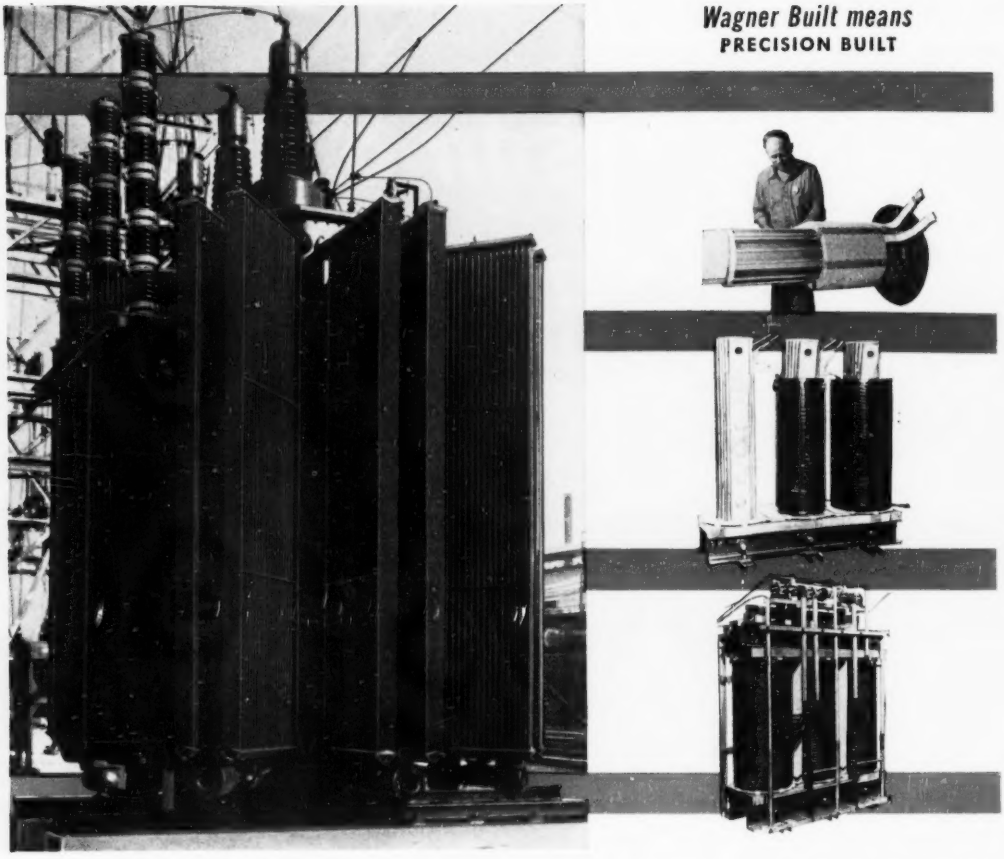
The cross section at the right shows the C-E Unit that recently was placed in service at the Port Jefferson Station. It is a 3-drum unit with 2-stage superheater. The boiler surface is followed by an economizer and regenerative type air heaters. The unit is designed for pulverized coal firing, using bowl mills and vertically-adjustable, tangential burners. Oil can be used as an alternate fuel and is being employed during initial operation pending completion of coal handling equipment.



— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E



BUILT TO A REPUTATION by Wagner

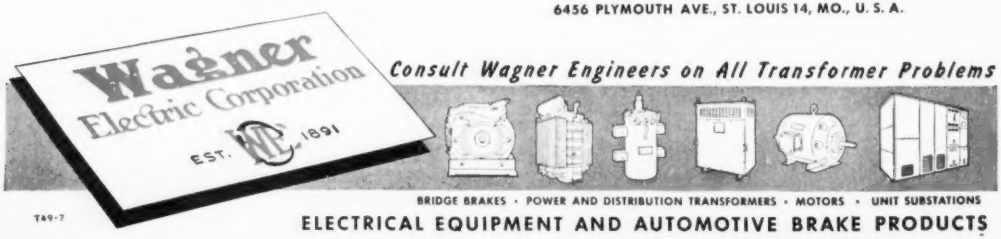
Wagner Power Transformers are transformers with a reputation for Quality—established through more than fifty-five years of service to the power industry. Meticulous attention to even the smallest details of construction is responsible for this reputation.

Liberal design, coupled with painstaking care in manufacture, has given Wagner Power Transformers the stamina to maintain a continuous flow of power, even under the frequent overloads demanded by today's requirements on system capacity.

Users of power transformers will find it to their advantage to consult Wagner on their next transformer installation. Users of Wagner transformers also profit by nationwide service facilities.

Twenty-nine branches, located in principal cities, and manned by trained field engineers, are at your service. Bulletins TU-180 and TU-181 give information on the complete line of Wagner Transformers.

Wagner Electric Corporation
6456 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.



Consult Wagner Engineers on All Transformer Problems

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL EQUIPMENT AND AUTOMOTIVE BRAKE PRODUCTS

T49-7

NEWS ABOUT PEOPLE

Boston Edison Executives Assigned New Duties

John T. Ward has been appointed vice-president in charge of engineering and operations, Boston Edison Co. He

JOHN T. WARD

joined the company in 1941 as head of the radio department. Previously Mr Ward had been associate professor of chemical engineering at the Massachusetts Institute of Technology and then director of the research laboratory for the M. W. Kellogg Co, New York. He became vice-president of the Boston utility in 1942 and has had increasing responsibilities in administration since.

Robert E. Dillon has been designated vice-president and assistant to the presi-

ROBERT E. DILLON

dent. His recent title of chief engineer has been eliminated for the present, and he will have immediate charge of the rate and statistics department, of which Russell Hastings is director, in addition to handling special assignments from president and general manager James V. Toner. Mr Dillon is widely known in the operating field through his long service as head of the production activities of the company and later as its chief engineer.

John A. Herlihy has been appointed assistant general manager. He will continue as vice-president in charge of procurement, stores and service.

Wilfrid L. Dwyer has been appointed acting merchandising manager of the company. Julius Daniels, for many years head of that branch, has been hospitalized for some months.

Coincident with the above management changes an operating committee has been formed to co-ordinate the functions of the production, transmission

JOHN A. HERLIHY

and distribution departments. This will have a chairman in rotation every two months, and it is planned for each member to serve during the next two years. Several meetings will be held weekly, and during his term each chairman is to be dissociated from his regular duties and serve as a connecting link between the departments and the vice-president in charge of engineering and operations. The members of the committee are C. A. Corney, chairman (who is also superintendent of engineering); H. W. H. Wellington, E. C. Rue, D. F. Tulloch, S. M. Jones, G. U. Parks, J. F. Archibald, G. A. Orrok, D. E. Washburn and H. L. R. Kurth. The engineering department, under Mr Corney, will continue to report to Mr Ward. Mr Corney will also supervise the technical standards and test section (generally known as the company's laboratory).

Ohio Brass Co Elects New Executive Officers

Announcement has been made by the Ohio Brass Co, Mansfield, Ohio, of the election of W. A. Springer as vice-president and treasurer and of Ephraim H. Brown as secretary. At the same time Louis J. Ott was appointed gen-

W. A. SPRINGER

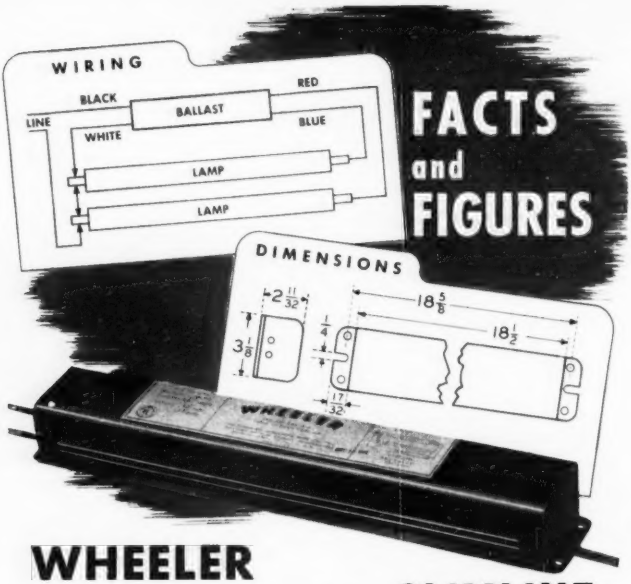
eral sales manager and R. A. LeFevre advertising manager.

Mr Springer started with the company in 1912, serving in various capacities including that of traffic man-

LOUIS J. OTT

ager and assistant treasurer. In 1930 he was elected treasurer and three years later became secretary-treasurer.

Mr Ott worked in the factory during summer vacations and joined the advertising department in 1928 following graduation from Amherst College. Since 1935 he has been advertising manager



FACTS and FIGURES

WHEELER BALLASTS FOR SLIMLINE

We believe a fluorescent ballast should — besides operating a lamp — give the user the assurance that he is incorporating into his product the best ballast obtainable. He should feel that he's getting quality materials assembled by experts and tested to rigid specifications before they go into his fixtures.

Wheeler ballasts for slimline lamps meet the most exacting requirements. They're designed to give added lamp life, with a minimum of operating heat and noise. They're rated conservatively, built to uniform standards of dimension and carry the Wheeler guarantee without reservation. All Wheeler ballasts for slimline fluorescent lamps are approved by Underwriters' Laboratories, Inc.

AVAILABLE NOW:

Wheeler two-lamp ballasts to operate the 96T8 slimline lamp at 200 and 300 milliamperes.

AVAILABLE SOON:

Wheeler ballasts to operate one and two slimline lamps for the other sizes and ratings.

Place your orders now. A Wheeler Ballast is good "insurance" for your slimline fluorescent application.

THE WHEELER INSULATED WIRE CO. INC.

SERVICE QUALITY WHEELER DEPENDABILITY

DIVISION OF THE SPERRY CORPORATION
1302 EAST AURORA STREET
WATERBURY 91, CONNECTICUT

MAGNET WIRE - COILS - COMMUNICATIONS EQUIPMENT

and, in addition during the war years he handled the company's relation with the War Production Board.

Mr. Brown, who had also worked in the factory during the summer vacations started in the sales department in 1924. He has been assistant to the president and to the senior vice president until his election as secretary.

Mr. LeFevre has been identified with the advertising department of the company since 1936.

Shea Elected President of Star Electric Motor

Harrie T. Shea has been elected president of the Star Electric Motor Co, Bloomfield, N. J., and Elvin E. Hallander, former president, has been made chairman of the board.

HARRIE T. SHEA

Since Mr Shea's release from the Army, he has been associated with Bear, Stearns & Co, investment bankers of New York, the principal stockholder of Star. For the past six months he has been active at Star as chairman of the executive committee of the board of directors.

Son of the late Emil E. Hallander, one of the founders of the company, Mr Hallander has been connected with the company and its affiliates for 17 years and has been president since 1946. He resigned as president to continue his own technical consultant service, which he has been conducting together with company responsibilities.

•

Fred E. Darr, formerly connected with the Menard Electric Cooperative, Petersburg, Ill., is now identified with the Illinois Valley Electric Cooperative at Princeton as public relations director.

Robert F. Edwards has been appointed section engineer in charge of the synchronous motor and vertical generator section of Elliott Co's Ridgway Division.

Important points to know about COTTRELL *Electrical Precipitators*

A COTTRELL Electrical Precipitator is a major plant investment. Once installed it is operated over a period of many years, *thus multiplying year after year the benefits of top notch design and installation.*

And because of the many factors affecting the operating and collecting efficiency of a COTTRELL Precipitator, probably in no other field do the experience and "know-how" of the organization designing and installing the unit play a more important role in influencing the overall performance of the installation. That is why it is so important to remember this fact . . .

Western Precipitation Corporation is the organization that installed the first successful COTTRELL Precipitator over 39 years ago, still operating efficiently . . . and has consistently developed new refinements, new techniques, new applications that today have made it world famous in the science of recovering dusts, fly ash, mists, fogs and other suspensions from gases.

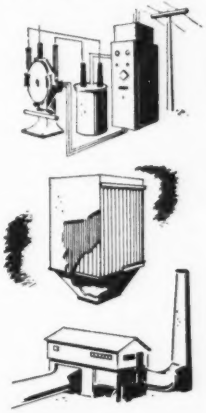
This is the first of a series of advertisements briefly outlining the important elements that go to make up a COTTRELL installation. Only long experience coupled with highest engineering ability, can assure the proper combination of these elements into a COTTRELL installation best suited to *your particular requirements*!

Basically, a Cottrell Precipitator consists of three major divisions each in turn consisting of many separate elements . . .

1. THE ENERGIZING SYSTEM, as its name implies, is the portion of the unit wherein the power is brought in, the voltage stepped up, then rectified to provide the unidirectional high voltage current supply for the Electrode System.

2. THE ELECTRODE SYSTEM consists of the high-tension ionizing electrodes and collecting electrodes through which the suspension-laden gas is passed to be cleaned. These electrodes can be of various designs, shapes and patterns and are equipped with various "rapper" arrangements which assist in keeping the electrodes clean of recovered materials.

3. THE HOUSING OR SHELL includes the structure containing the Electrode and Energizing Systems as well as the gas ducts and distributing system, the hoppers for receiving the collected material and other miscellaneous equipment.



Each of these three major divisions, together with their many individual parts, must be carefully engineered into ONE integrated and precisely-balanced unit to provide the successful and continuously-operating COTTRELL Precipitator. This series will take these major units apart to show in greater detail how the individual parts function and the varying types of design and construction. Watch for them.

10 COTTRELL ADVANTAGES

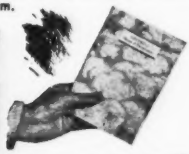
that make Cottrells unsurpassed for all types of recovery problems, hot or cold, wet or dry

1. **LOWEST DRAFT LOSS** — only a few tenths of an inch w. g.
2. **LOWEST POWER COST** — only ½ to 1 kwh. per 100,000 cu. ft. of gas cleaned.
3. **LOWEST MAINTENANCE COST** — all metal, few moving parts, no fire hazard.
4. **LOWEST LABOR COST** — operation can be fully automatic, if desired.
5. **LONGEST LIFE** — early Cottrell installation still operating after 39 years of continuous service.
6. **HIGHEST EFFICIENCY** — recovery efficiently approaches 100%, is desired.
7. **UNIVERSAL APPLICABILITY** — recover any suspension, solid or liquid — in any gas — over wide temperature ranges.
8. **ANY CAPACITY** — handle a few c.f.m. — or millions — with equal ease.
9. **MAXIMUM FLEXIBILITY** — readily adaptable to varying installation requirements.
10. **LOWEST OVERALL COST** — cost less per year of service, less per ton recovered. Often pay for themselves in a few months — always within a few years.

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1004 WEST NINTH STREET, LOS ANGELES 13, CALIFORNIA
CHRYSLER BLDG., NEW YORK 17 • 1 LaSALLE ST. BLDG., 1 N. La SALLE ST., CHICAGO 2 • HOBART BUILDING, SAN FRANCISCO 4, CALIFORNIA
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL



Do You Have This Helpful COTTRELL Booklet? In 28 pages of interesting charts, illustrations and descriptive data, it answers many of the questions engineers ask about COTTRELL design and construction. Send for your free copy. Ask for Bulletin C103!

Depend on ALBION-DILLON ANCHORS

for Long Reliable Service

Made of Malleable Iron

You can rely on ALBION-DILLON expanding type anchors for *lasting* strength and holding power. For A-D Anchors are made with malleable iron to take advantage of its high tensile strength, toughness, resistance to corrosion and other outstanding features.

Three long cone-slanted blades (80% of anchor area is in the blades) dig neatly into solid earth to provide maximum holding power. Tests have shown that A-D Anchors will withstand a 46,000 pound pull!

Three sizes — 3", 4" and 6" — with two variations of blade spread in the 6" size are available. Rods are not supplied.

ORDER A-D ANCHORS FROM YOUR DISTRIBUTOR.

INSTALLED QUICKLY, SECURELY

A-D Anchors are easy to install. Attach rod and drop anchor to bottom of hole. A few blows with a spud or installing tool breaks light wire (used to hold blades together) and starts blades expanding outward. Added blows force blades into the solid earth until they're locked into position.

Send for Folder

A descriptive bulletin, specifications and prices are available. Send for yours.

ALBION MALLEABLE IRON CO.

"One of America's Foremost Producers of Malleable Iron"

ALBION, MICHIGAN

Prior to joining Elliott in this capacity, Mr Edwards was engaged in the design of both large and medium-sized synchronous motors.

Andrew H. Grimsley has retired from the Federal Power Commission after 15 years of service. He was chief of the consolidations section of the commission's bureau of power at the time of his retirement. Prior to his connection with FPC, Mr Grimsley was engaged in varied engineering work for more than 35 years. While serving as vice-president and general manager of Virginia Public Service Co, Charlottesville, he consolidated six operating companies and established the central operating organization for the National Public Service Co. Later he became vice-president of the General Engineering & Management Co of New York in charge of Western United Gas & Electric Corp properties.

R. Plymire, assistant manager of the central division of the Puget Sound Power & Light Co at Seattle, Wash., has been promoted to the position of assistant to the executive vice-president. He started with the company as a meter tester in 1930. He has since worked as a clerk, substation operator, appraiser, local manager, supervisor in the rate department, and central division suburban manager.

John S. Garceau has been appointed to a newly created position on the executive staff of York Corp, York, Pa.. Mr Garceau will be responsible for direction of advertising and sales promotion programs for all divisions of the corporation. **J. Donald Smith**, who has been advertising manager for the past four years, will continue in that capacity. Mr Garceau was formerly connected with Farnsworth Television & Radio Corp. Previous connections included Kelvinator and Fairbanks-Morse.

Paul Kiel and **Ken Eaton**, formerly connected with the Copper Wire Engineering Association, have joined Anaconda Wire & Cable Co. Their assignments cover REA co-ops. Mr Kiel working out of the Dallas office and Mr Eaton out of Denver.

Fred W. Meyer has been named chief engineer of Bechtel Corp's engineering division, with headquarters at the company's San Francisco office. Mr Meyer joined Bechtel in 1942, following seven years of refinery design and process engineering with the Standard Oil Co of California.

W. H. Magee has been appointed general sales manager of Russell Electric Co, Chicago, subsidiary of Raytheon Manufacturing Co. During the past four

WHAT ABOUT

High-Altitude Brush Principles

FOR GROUND-LEVEL ROTATING ELECTRICAL EQUIPMENT?

When Stackpole produced the first long-life brushes for high-altitude aircraft generator service, it looked as though these same unique principles of brush composition would also solve a lot of brush problems in equipment for ground level use where difficult atmospheric conditions, chemical fumes and other adverse conditions were causing trouble.

In some instances, outstanding success was achieved. In others—and it was hard then to tell exactly why—results were disappointing.

That was several years ago. Meanwhile, subsequent Stackpole developments in high-altitude brush compositions and production control methods have scored real progress in solving these more puzzling ground-level applications. In a high percentage of cases, they have resulted in materially longer brush life under adverse conditions, greatly minimized commutator wear and generally improved standards of equipment operating efficiency.

TEST OFFER! Send details of your difficult ground level applications for sample brushes. *Test them on your actual equipment under actual operating conditions.* Recent experience indicates that, in a large majority of cases you will find that these unique brushes answer your problem.

NOTE: Stackpole brushes are sold only to equipment manufacturers—not as replacements.

STACKPOLE CARBON COMPANY, St. Marys, Pa.

STACKPOLE

MOLDED CARBON, GRAPHITE AND POWDERED METAL SPECIALTIES . . . *Write for details on any type*

BATTERY CARBONS • BEARINGS • BRAZING FURNACE BOATS • BRUSHES • CARBON, GRAPHITE AND METAL CONTACTS • CARBON VOLTAGE REGULATOR DISCS • CHEMICAL CARBONS • CLUTCH RINGS • DASH POT PLUNGERS • POWER TUBE ANODES • RESISTANCE WELDING AND BRAZING TIPS • SEAL RINGS • SPECIAL MOLDS AND DIES • TROLLEY AND PANTOGRAPH SHOES • WATER HEATER & PASTEURIZATION ELECTRODES • WELDING CARBONS, ETC.

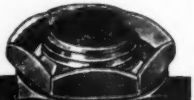
TIGHT CONNECTIONS
assured by using
PALNUT
TRADE MARK
SELF-LOCKING NUTS

● The Railway & Industrial Engineering Co. overlooks no detail to insure years of satisfactory service from its products. An example is the use of PALNUTS to assure permanently tight nut-and-bolt assemblies on its line of fittings, switches, clamps, cutouts and other R. & I. E. equipment.

TIGHT connections are vital in the distribution and transmission of power. That's why you see PALNUTS on wood pole lines, steel transmission towers, bus fittings, connectors, switchboards, terminals, substations and other electrical equipment.
PALNUTS apply quickly on top of regular nuts, holding them to original tightness under severe vibration. No check-ups or re-tightening are required. On electrical connections, perfect conductivity is maintained. PALNUTS are available in a wide range of sizes in plain spring tempered steel; also hot-dip galvanized and silicon bronze for weather resistance.
Send details of your needs for samples. Write for literature on entire line.

THE PALNUT CO.

51 Cordier St.,
Irvington 11,
N. J.



DOUBLE-LOCKING
PALNUTS
Reg U S Pat Off

years, Mr Magee was Midwest sales manager of U. S. Gauge Co Division of American Machine & Metals, Inc.

OBITUARY

Jacob Hekma, a vice-president of the Commonwealth & Southern Corp, died in Palm Beach, Fla., on Feb 17 at the age of 69. His home was in Greenwich, Conn. Born in The Netherlands, he came to the United States in 1884, settling in Grand Rapids, Mich. He began his business career with the Michigan Trust Co there, resigning in 1905 to join the staff of Hodenpyl, Hardy & Co in New York. He became identified with the Consumers Power Co, Jackson, Mich., in 1910 and after serving in the positions of assistant secretary, secretary, and treasurer, he was made a vice-president in 1920. He became associated with Commonwealth & Southern when it was organized in 1929. At the time of his death he was a director of Consumers Power Co and of Ohio Edison.

Charles D. Warren, formerly vice-president and secretary of the Buffalo Niagara Electric Corp, Buffalo, N. Y., died on Feb 13. He was 69 years old. Born in Niagara Falls, Ont., Mr Warren later went to Buffalo and began his utility career in 1911 as secretary to the president of the old Buffalo General Electric Co. In 1930 he was made secretary and vice-president of the company. When Buffalo Niagara Electric was organized in 1937 Mr Warren became secretary and vice-president of the new corporation. He retired in 1944. Mr Warren was also assistant secretary of the Niagara Falls Power Co, the old Niagara, Lockport & Ontario Power Co, the old Lower Niagara River Power & Water Supply Co and the old Niagara Junction Railway Co.

Harry W. Beedle, 70, retired manager of the Boston branch of the Electric Storage Battery Co, died at Boston Feb 3. Born in Gardiner, Me., he earlier had been an electrical engineer with the Bell Telephone System in Canada.

Cornelius W. Woodward, who was associated with the Electric Storage Battery Co for many years before he retired in 1940, died on Feb 9 at his home in Chestnut Hill, Pa. He was 70 years old.

Arthur C. Kingston, 72, retired vice-president of the Boston Woven Hose & Rubber Co, Cambridge, Mass., died at Belmont, Mass., on Feb 6.

Charles H. Hodge, a hydroelectric engineer with the Central Hudson Gas & Electric Corp, Poughkeepsie, N. Y., for 35 years, died on Feb 14 at the age of 58.

Here are up-to-the-minute
- **facts and figures**
- **methods and materials**

from all fields of
ELECTRICAL
ENGINEERING

HERE'S an encyclopedia of facts and figures, definitions, conversion factors, physical and mathematical principles, accepted formulas, and experimental data—all brought up-to-date to help you meet today's requirements. This handbook offers the essential electrical engineering information you want in compact, easy-to-use form that ensures quick, fingertip reference on any problem you meet.

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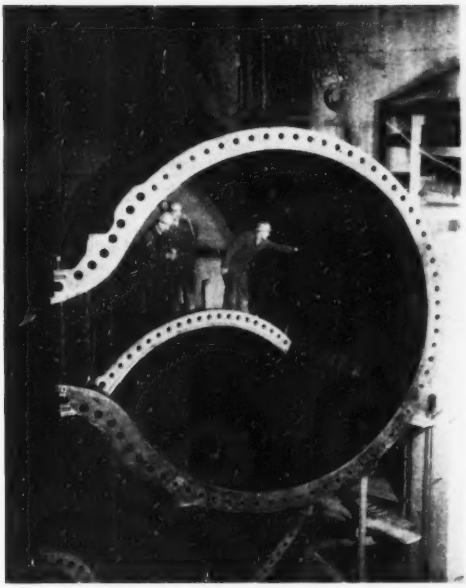


RECORD OUTPUT
FOR GRAND COULEE USING NEWPORT NEWS TURBINES

During 1948 the nine generating units in the west power house at Grand Coulee in the state of Washington produced 8,415,000,000 Kw.

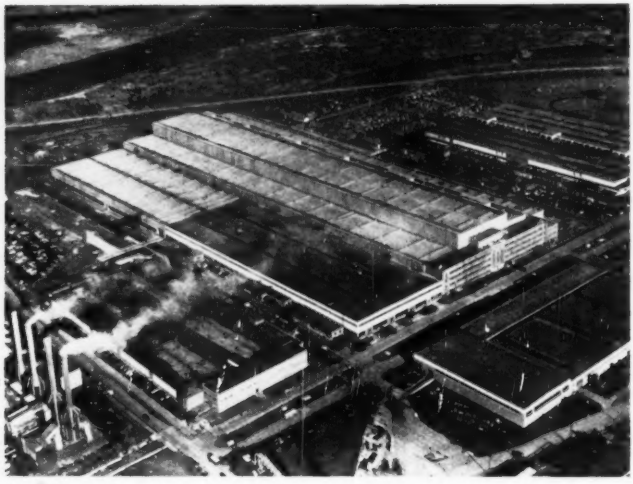
Each generator was driven by a 150,000 horsepower hydraulic turbine built by Newport News.

Six similar turbines, but of 165,000 horsepower capacity are now being built for the east power house, which also has space for nine units.

WRITE FOR BOOKLET
"WATER POWER EQUIPMENT"

NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY
NEWPORT NEWS, VIRGINIA

MANUFACTURERS and MARKETS



AIRVIEW of General Electric's huge new turbine building nearing completion at Schenectady, N. Y. The 20-acre plant (center) will be capable of producing turbine-generators ranging from 20,000 kw to 200,000 kw. Movement of heavy machinery into the $30,000,000 building was begun recently. As soon as each machine tool is installed, production of component turbine parts gets underway

GE Cuts Air Conditioner Prices; Plans Promotion

Maintaining that the market for refrigeration and air conditioning is far greater than prewar but asserting that intensive competitive selling is now in order, General Electric Co cut prices last week on its packaged commercial refrigeration and air conditioning by an average of 10 to 12%.

To round out its air-conditioning line the company has added new units of 2, 7½, and 10 hp to its group of packaged air conditioners, which has included only 3 and 5 hp units to date. It also plans to establish between 50 and 75 parts depots throughout the country which will permit users of its refrigeration equipment machines to obtain replacement parts within 24 hours.

Simultaneously the company is instituting two changes in pricing policy, one designed to protect distributors and dealers against further possible price reductions, and the other to protect contractors using mainly heavier types of non-packaged, remote-installation equipment against possible price rises. Distributors and dealers are afforded the benefits of an arrangement whereby any packaged commercial refrigeration or air conditioning units ordered within 90 days preceding a price reduction will be billed at the reduced price. Contractors in the field, who have been purchasing equipment under escalator arrangements whereby billings increase if prices rise prior to delivery will hereafter be quoted firm prices, according to the announcement.

Intensive promotion of air conditioning, automatic heating, and refrigeration, principally in commercial applications, is being carried on this month by General Electric in a country-wide series of distributor-dealer sales meetings. Announced purpose of the meetings is to start a "Shirt Sleeves Selling" program. Improved models and additions to lines are shown. For each line of products dealers are offered a packaged promotion program, including broadsides, mailing pieces, prospect cards, envelope stuffers, and other selling aids.

India Proceeds with Plans for $45,000,000 Plant

Going ahead rapidly with its plans for establishment of a $45,000,000 plant to manufacture heavy electric generating equipment, transformers, and allied products, the Indian government has signed a contract with the Associated Electrical Co. Ltd. of Britain for a survey and preparation of plans and is expected to call for a similar job shortly from International General Electric, Inc.

After the two surveys have been compared, one of the companies will be given the contract for supervising the construction, importing and setting up the equipment, and training Indian personnel. Under present plans the plant will be owned outright by the Indian government.

The project reports are to be presented in about six months.

Contracts are expected to be signed soon for supply and installation of two new generating stations for Indian power projects. Bids are being examined for the first thermal station in the Damodar Valley development scheme. It will be a 200,000-kw unit at Bokaro in the Bihar coal fields.

Meanwhile, bids have been asked for the supply of six 8,500-kw and three 6,800-kw hydroelectric generating units, plus switchgear and transformers, for the Yamuna and Pathri hydroelectric projects in north central India.

•

Westinghouse Steps Up Refrigerator Production

Refrigerator production workers of the Westinghouse Electric Appliance Division plant at Mansfield, Ohio, have begun a six-day work week to step up manufacturing of the company's line. J. H. Ashbaugh, vice-president, has recently announced.

Approximately 1,600 workers will benefit from the extra day of work at time and a half overtime pay. The company also added 100 new employees to the payroll to help meet the increased production schedule. Employment at the 42-acre appliance-producing plant is now more than 8,100, highest in its 31-year history.

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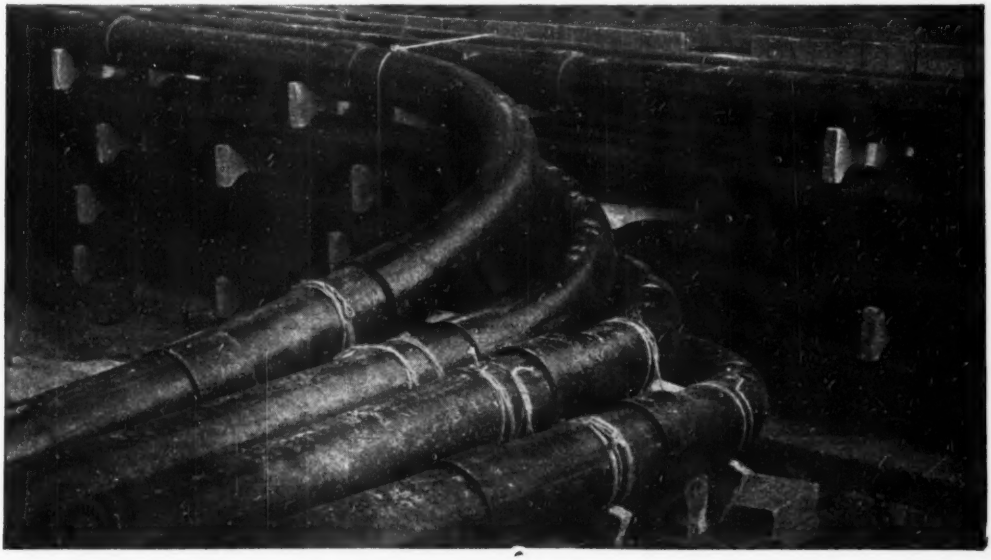

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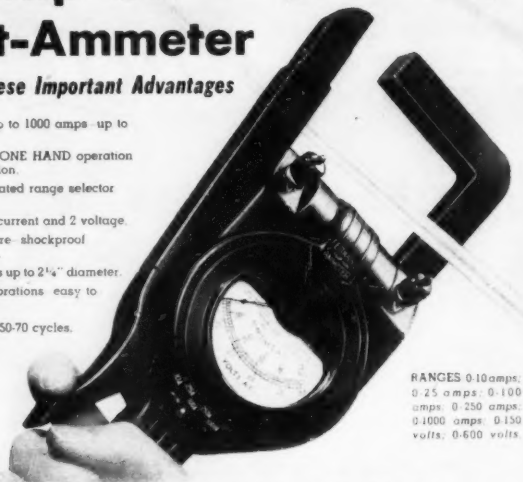

RANGES 0-10 *amps*; 0-25 *amps*; 0-100 *amps*; 0-250 *amps*; 0-1000 *amps*; 0-150 *volts*; 0-600 *volts*.

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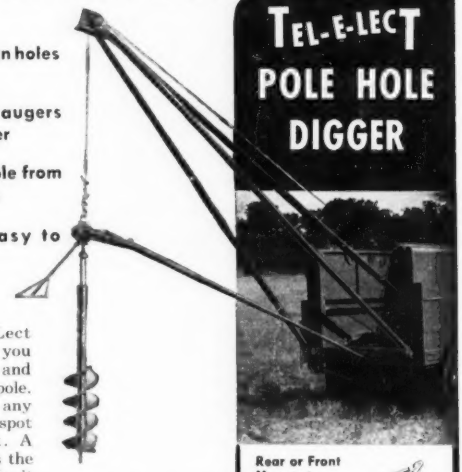
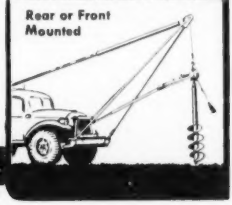


WITH the Tel-E-Lect Pole Hole Digger, you use the same truck and crew that sets the pole. You can drill a hole any place that you can spot the pole derrick. A single bolt attaches the digger to the truck; it works suspended from the derrick. Powered by the truck motor through a power take-off shaft, Tel-E-Lect is raised and lowered by the winch line. Fits the budget of even the smallest utility, and quickly pays for itself. *Ask for circular.*



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mand for this increased volume and our confidence is based on our sincere belief that 1949 will be another good year for general business in the United States," Mr Ashbaugh stated.

•

Manufacturers Make New Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

Line Material Co, Milwaukee, Wis., has appointed J. L. Shannon to its southeastern Michigan territory with offices in Detroit. R. L. Mansur has joined L-M's eastern division with headquarters at Cambridge, Mass., and W. E. Goodman will serve the Memphis, Tenn., district.

S & C Electric Co., Chicago, has appointed Lawrence M. Rudbeck as sales engineer for the Indiana, western Kentucky, and southern Illinois territory, with headquarters at 310 Test Bldg, 54 Memorial Circle, Indianapolis 4.

General Electric Co has named A. R. Hines manager of the recently established sales district of the apparatus department for the State of Michigan, with headquarters in Detroit. Formerly a part of the central district with headquarters in Chicago, the newly-constituted Michigan district will include present local sales offices in Detroit, Lansing, Jackson, Grand Rapids, and Saginaw.

Standard Transformer Co. Warren, Ohio, has made Robert P. Smith, 123 W. Beaver St, Jacksonville, Fla., its representative for the State of Florida.

Cannon Electric Development Co, Los Angeles, has made Leroy W. Beier, 600 So. Michigan Ave, Chicago 5, its representative in the Chicago area, including northern Indiana counties, northern Illinois and eastern Iowa.

•

Locke Makes New Rods

Locke, Inc. Baltimore, Md., has announced that it is now making available a new line of preformed armor rods, which are pre-twisted at the factory to fit any size and type of conductor. By preforming the rods at the factory, the need for clips, clamps, and special tools is eliminated. The rods are available in either aluminum alloy, galvanized steel, bronze, or copper.

•

Complete $50,000 Addition

Completion of a $50,000 wing on its plant at 56th St and 37th Av, Woodside, New York, has been announced by S. I. Slater, president of Slater Electric & Mfg Co, Inc. Included in the expansion program are three of the newest type fully automatic molding presses which have increased molding capacity by 25%.

LONDON and BIRMINGHAM

BRITISH INDUSTRIES FAIR

Britain has long been the world's greatest customer, and has led the way in the export of manufactured products. By initiative in modern research, and from experience of commerce with other nations, her industrial production has become greater and more varied than ever in history.

Renowned for the quality of her work, Britain has applied new technique to her famous industries. By enterprise in fresh markets she has achieved record deliveries, and export production still expands. To keep in touch with these developments great numbers of the world's principal buyers are making visits to Britain.

Every year, from over 100 countries, trade buyers gather at the British Industries Fair. The Chamber of Commerce in Birmingham, and manufacturers from every part of Britain, join with the British Government to welcome them.

At BIF 1949, from 2–13 May, three thousand exhibitors will display the latest developments in thirty groups of allied trades. The leading men of international commerce are invited to attend the world's greatest assembly of national products.

2-13 MAY 1949

TRADE BUYERS—PLAN YOUR VISIT NOW

Information about exhibitors, special displays and facilities at the Fair can be obtained from the nearest British Embassy, Legation or Consulate.

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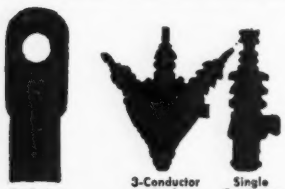

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NEW ELECTRICAL CONSTRUCTION

A weekly selection of U. S. electrical construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is indicated or implied

UTILITIES

Proposed Construction

Arizona — California-Nevada-Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Boulder City, Nev., 2 governors for regulating speed of 115,000 hp. hydraulic turbines for Units A 3 and A 4 in Hoover Power Plant, Boulder Canyon Proj., Spec. 2571. L. N. McClellan, ch. engr.

Arizona and Nevada—Bureau Reclamation Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or Coolidge Ariz., outdoor auto-transformers; station-type lightning arresters; ungrounded-neutral circuits; outdoor, power circuit breakers; outdoor disconnecting switches; grounded-neutral circuit; outdoor current transformers, for Coolidge substation, Davis Dam proj., Spec. 2573. L. N. McClellan, ch. engr.

Arkansas—Ouachita Rural Electric Cooperative, Camden, rural distr. lines to serve rural customers, Ouachita Co. **$530,000**. Southwest Electric Engineers, Jonesboro, consult. engrs.

Arkansas—U. S. Eng., 300 Broadway, Little Rock, install and wire powerhouse and switchboard equip. at Norfolk Dam, incl. switchboards, power transformers, etc. Inv. Eng. 03-050-47-37.

Ark., Ozark—Arkansas Electric Co-operative, Ozark, steam generating plant. **$5,480,000**.

Calif., San Diego—San Diego Gas & Electric Co., 861 6 Ave., 60 mi. 16 in. gas pipeline, **$3,100,000**; 40,000,000 cu. ft. storage plant **$1,300,000**; electric transmission line, **$900,000**; generating unit, **$2,750,000**.

Illinois—Jo-Carroll Electric Co-operative, Elizabeth, 119 mi. rural distr. lines, Carroll Co. **$310,000**.

Iowa—South-East Iowa Co-operative Electric Assn., Mt. Pleasant, rural distr. lines, Perry Co. **$1,378,000**. Stanley Eng. Co., Muscatine, consult. engr.

Minn., Minneapolis—Northern States Power Co., 15 S. 5 St., S. Keely, constr. supt., 60,000 kw. generating plant, Lyndale Ave. S. at Minnesota River. **$10,000,000**.

Missouri—Missouri Rural Electric Co-operative Assn., F. H. Schmit, mgr., Palmyra, rural distr. line extens., and sys. imprvs., Marion Co. **$410,000**.

North Dakota—Devenue Valley Electric Co-operative, Finley, 518 mi. rural distr. lines, sys. imprvs. and completing previously approved constr., Steele Co. **$1,230,000**.

Ohio—Riverdale Belt Conveyor Lines, Inc., c/o H. B. Stewart, Jr., Akron, Canton & Youngstown R. R. Co., 12 Exchange St., Akron, Zone 8, two-way 130 mi. conveyor belt from Lorain to Lake Erie-East Liverpool on Ohio River. **$154,000,000**; terminal facilities, **$56,000,000**.

Oregon—U. S. Eng., Pittock Block, Portland, 2 turbines and governors, Detroit Dam. Est. $1,000,000-$2,000,000.

Texas—Stamford Electric Co-operative, Stamford, 167 mi. rural distr. lines, sys. imprvs., completing previously approved constr., Jones Co. **$315,000**.

Washington—Bonneville Power Admin., 729 N.E. Oregon St., Portland, Ore., 34 mi. Foster Creek-Columbia River Sect. Foster Creek-Snohomish 230 kv. transmission line, Douglas Co., Inv. 4502. Plans deposit $25.

Wash., Seattle—City, County—City Bldg., Zone 4, construction contract on powerhouse, penstock tunnel and appurtenant works for Unit 24 of Gorge powerhouse exten. Over $250,000. E. R. Hoffman, city light supt.

Wyoming—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., 1 control and relay board, 2 distribution panel boards and 1 battery charger for Hanna sub-station, Kendrick Proj., Spec. 2566.

Low Bidders & Contracts Awarded

California—Bureau Reclamation, Dpt. Interior, Redding, Feb. 9, completing Keswick Dam and power plant on Sacramento River, Central Valley Proj., Spec. 2479, from C. M. Elliott & John C. Gist, 1020 46 St., Sacramento, **$1,239,409**.

Calif., Antioch—Pacific Gas & Electric Co., 245 Market St., San Francisco, 300,000 kw. steam electric power generation station, Contra Costa Steam Plant, to Bechtel Corp., 200 Bush St., San Francisco, Est. **$51,500,000**.

Minn., Maple Lake—Rural Co-operative Power Assn., O. M. Gravgaard, pres., Maple Lake, furnishing steam electric generator and auxiliaries, to Springfield Boiler Co., 1967 E. Capitol Ave., Springfield, Ill., **$329,058**. Bids 1/25.

Neb., Lincoln—Loup River Public Power Dist., Columbus, design and constr., 5 story power plant addn., to Stearns-Rogers Co., 1720 California St., Denver, Colo., Est. **$3,000,000**, incl. equip.

South Carolina—Santee Electric Co-operative, Inc., Kingstree, Feb. 10, 192 mi. rural distr. lines, Williamsburg, Florence, Georgetown and Clarendon Counties, from Seastrunk Electric Co., 1731 Harden St., Columbia, **$97,500**. McCall-Thomas Eng. Co., Inc., Orangeburg, engr.

Tennessee—Cumberland Electric Membership Corp., Clarksville, Feb. 2, 337 mi. rural distr. lines, Stewart, Montgomery, Robertson, Cheatham and Summer Counties, from Utilities Constr. Co., Exchange Bldg., Nashville, **$493,687**.

Tex., Houston—Houston Light & Power Co., Electric Bldg., Fort Worth, power plant unit, concrete, hollow tile walls, rein.-con. fdn., 500 St. Andrews St., force account. **$85,000**.

Tex., San Antonio—San Antonio Television Station, H. H. Coffield & Assoc., Gunter Hotel, television station, (Station KEYL), own forces. **$175,000**.

Washington—Bonneville Power Admin., 729 N.E. Oregon St., Portland, Ore., 32.04 mi. Index-Snohomish Sect. Foster Creek-Snohomish 230 kv. transmission line, Snohomish Co., Inv. 4429, to Smith Bros., Vancouver, **$578,165**. Bids 1/4, awarded 2/8.

Washington—Bonneville Power Admin., 729 N.E. Oregon St., Portland, Ore., supplying towers for Olympia-Covington transmission line, Thurston Co., to Isaacson Iron Wks., 2917 E. Marginal Way, Seattle, **$524,683**. Bids 1/23, awarded 2/8.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

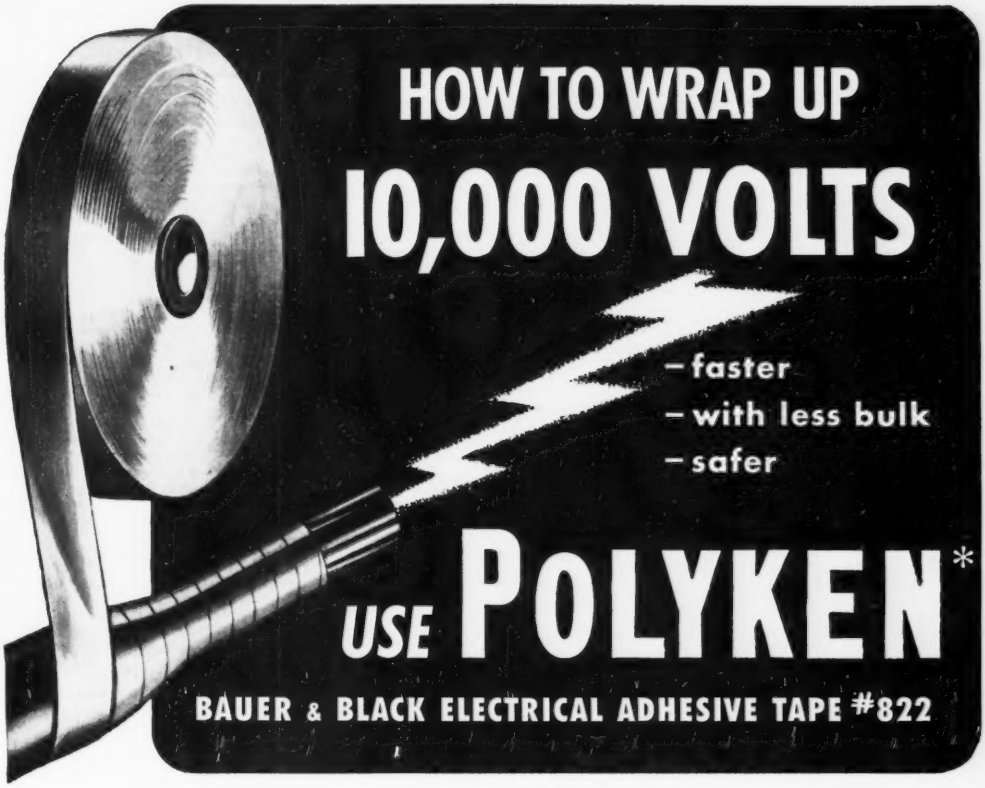
Ill., Chicago—State of Illinois, Springfield, plans by C. Herrick Hammond, state archt., 53 W. Jackson Blvd., and Philip B. Maher, 157 E. Erie St., 8½ story, rein.-con., brick, stone tuberculosis hospital, in West Side Medical Center, of Medical Center Comn. **$5,000,000**.

Mass., Boston—P. Bldgs. Admin., 18 and F Sts. N.W., Wash. 25, D. C., federal bldg., Stuart St., between Trinity Pl. and Clarendon St. **$20,500,000**.

Low Bidders & Contracts Awarded

Calif., Berkeley—Regents University of California Berkeley, Feb. 19, 4 story, 100,000 sq. ft., rein.-con. engineering bldg., from James I. Barnes Constr. Co., 1110 Montana Ave., Santa Monica, **$1,084,000**.

Ind., Indianapolis—Glidden Co., 1160 W. 18 St., two 4 story masonry, steel, rein.-con. plants, 1160 W. 16 St., to Chemical Plants Division, Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa. Est. **$3,000,000**.



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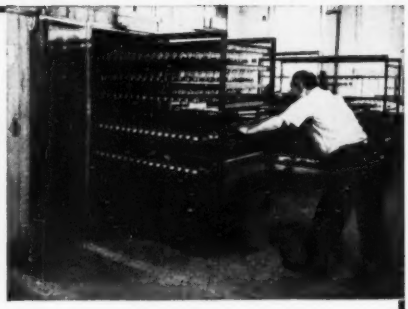

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CURING — Does this varnish cure completely after final bake? *Acme Thermosetting Varnishes insure thorough cure throughout entire varnish mass, the absolute preventive of solvent traps.*

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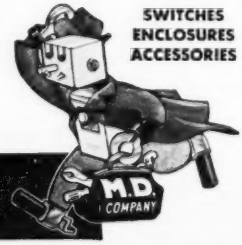

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RECENT RATE CHANGES

EDISON LIGHT & POWER Co, York, Pa., was sustained by the state Public Utility Commission when the board dismissed a group of complaints against domestic and rural electric rates charged by the utility. The commission found that the rates are "not excessive and unreasonable and are justified." In an order dismissing the complaints of the City of York, York Chamber of Commerce, Manufacturers' Association of York, C. R. Seely and Robert E. Gephart, both York, the PUC terminated an investigation started on its own motion March 17, 1947. The rates complained against became effective automatically on Jan 17, 1948, having been suspended from the previous April 17. They increased Edison's gross revenues approximately $397,417 a year, on the basis of 1947 business.

COLUMBUS & SOUTHERN OHIO ELECTRIC Co, Columbus, will levy an additional 2% surcharge beginning in March against all consumers of power serviced by the utility company. A surcharge of 4.4% was levied against consumers of the company in August. The increase of 2% more would increase the total surcharge to 6.4%. John B. Poston, president, said that under contracts between the company and the various municipalities, the utility may apply a 0.4 of one percent surcharge for each full one-cent increase in the unit cost per kwhr. Mr Poston pointed out, however, that the utility cannot apply the surcharge until operating expenses are increased by 5%. The revenues collected by the company under the original 4.4% surcharge are being impounded in a bank pending determination of an injunction suit filed by City Attorney Richard W. Gordon of Columbus. The city plans to ask impoundment of receipts on the added surcharge until the case against the original 4.4% surtax is decided.

DUQUESNE LIGHT Co, Pittsburgh, has filed with the state Public Utility Commission a tariff supplement, effective April 1, 1949, which proposes an increase in rates for 16,739 commercial and industrial customers. The tariff change calls for extension of the fuel adjustment clause to cover all energy billed under its Rate "W". The fuel adjustment clause now applies only to that energy billed in excess of the first 10,000 kwhr monthly. The company estimated that the fuel adjustment clause revision would increase its annual revenue by $665,220.

•

Organizes Sales Agency

Announcement has been made of the formation of the Terry Machinery Co, Hanna Bldg, Cleveland, Ohio, as a sales agency for metal-working machinery. C. R. Terry, organizer, has just completed eleven years as sales engineer for the Hydraulic Press Manufacturing Co, Gilead, Ohio, and was formerly buyer of machinery for the B. F. Goodrich Co, Akron. During the early stages of World War II, while on leave of absence from his company, Mr Terry organized the Ohio OPM offices and served as Cleveland manager and state director.

Voltage Regulation

(Continued from page 76)

shown in Fig 8 would become wider and the voltage spread likewise would be greater. Therefore, if the errors are sufficiently large, the permissible voltage drop in load area portion of the circuit will have to be reduced to limit the voltage spread to 10%. (See *Feeder Voltage Regulator Accuracy Standards* by W. E. Birchard. AIEE Paper 48-177, March 1948.

The amount of load that can be carried by a feeder depends upon the voltage drop between the first and last transformer. To reduce this drop more money is invested sometimes for copper in the feeder. This investment is less if the band width and control circuit errors are reduced.

Branch Feeder Regulation

Branch feeder regulation requires a slightly different viewpoint in application. In urban circuits the value of 10% voltage spread between the first and last customer has established recognition as a good design value. But in rural circuits, 13% voltage spread is a good compromise. Naturally, the cost of electric service increases as the voltage spread is reduced, and the value of 13% is based upon economics vs required quality of service. A voltage profile of a rural feeder with a regulating device installed is shown in Fig 9. Usually for this type of service the primary voltage on any transformer should not be more than 5% above nor be less than 3% below the nominal system voltage. (See EEI-NEMA joint committee report on preferred voltage ratings for a-c systems and equipment.) Compared to urban circuits, secondaries in rural circuits generally are shorter and voltage drops are less. In Fig 9, voltage drops in the distribution transformer, secondary, and service are lumped together and shown as one value, 5%. The same kind of reasoning is applied to determine the maximum voltage spread between any two customers in the given load area as for urban circuits or feeders. That is, the first transformer is considered lightly loaded or the voltage drop negligible and the last transformer is considered to be fully loaded. The actual voltage drop in the feeder between the first and last transformer is 16% and the voltage drop through the last transformer, secondary and service is 5%. Hence, without a regulator, the total voltage spread is 21%. By installing a regulating device and boosting to the allowable maximum voltage limit of 105%, the net voltage drop in the primary between the first and last transformer is 8%. Therefore, the net voltage spread between the first and last customers is 13%.

In this circuit, the regulating device has effectively reduced voltage drop 8% in the primary. Comparison of the cost of the regulating device with the cost of larger copper in the feeder will economically justify the regulator installation.

Regardless of the types of regulation, circuit or loading conditions, the ultimate permissible primary feeder voltage drop, as available for design of the feeder, is derived from the voltage drop between the first and last transformer. This drop for:

SINGLE-PHASE regulation is the voltage drop between the first and last transformer on any given phase.

THREE-PHASE or individual feeder regulation is the difference between the highest primary voltage of any transformer and the lowest primary voltage of any transformer that can be expected on the given feeder.

BUS REGULATION is the difference between the highest primary voltage of any transformer and the lowest primary voltage of any transformer on any feeder supplied by the given bus.

Basis of Urban Feeder Spread

The typical value of the maximum voltage spread between customers (at the meters) in the load-area portion of urban feeders is 10%, which is based upon the requirements of users equipment. Subtraction of the voltage drops in the last transformer, secondary circuit and service leaves the availability of 3% for the optimum permissible voltage drop between the primary of the first transformer and the primary of the last transformer.

As has been shown in some systems, the design value must be less than the optimum value depending upon the type of regulation (bus, individual feeder, 3-phase, and single-phase) and conditions such as: (1) Unbalanced loads, (2) unequal impedances or circuit lengths, (3) different load pattern between phases or feeders, and (4) large band width and large control inaccuracies.

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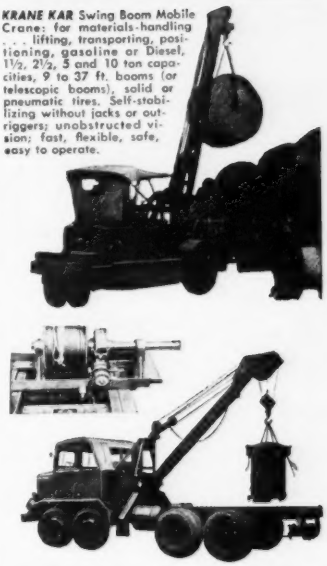

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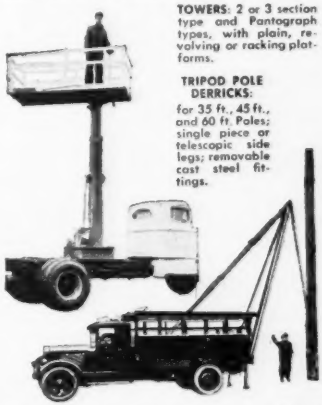

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May 21st

IT'S COMING MAY 21ST

Switching Faults Studied

(Continued from page 82)

considerable length, such as a 66-kv line, the cable should be opened at the remote end so as to de-energize the line and transformer as a unit; the line and transformer should never be separated. A neutral connection to ground on the transformer will help to reduce the duration and magnitude of the transient voltages.

B. *De-energizing Large Underground Cables.* Where possible, cables should be de-energized by switching out the transformer supplying them, so as to de-energize the transformer and cable as a unit. A cable fed from a single transformer should not be de-energized by separating it from the transformer. Here again, a neutral connection to ground on the transformer will reduce the hazard. If no transformer is available the cable should be de-energized at the terminal nearest a transformer neutral connection to ground.

Heat-Pump Water Heater

(Continued from page 69)

in such a manner to make available higher temperature water with no apparent effect on the discharge pressure of the compressor.

If final water temperatures lower than those obtained in Test Series No. 5 were acceptable, a much higher coefficient of performance would be obtained. For instance, if a 140 F temperature in the top compartment would meet the requirement, the coefficient of performance of 3.88 would be obtained for the compressor motor only, and 3.27 for the compressor motor and auxiliaries. The higher coefficient of performance would be the value expected if a gravity type evaporator was used in place of the forced air evaporator.

The makeup water to the water storage tank was 60 F for most of the tests and the air temperature to the evaporator was 70 F or higher. During the winter months a lower makeup water temperature could be expected which would raise the average coefficient of performance during this period. Conversely, the entering air temperature to the evaporator would probably be lower during the winter than that used to lower the average coefficient during this period.

Invisible Balance Sheet

(Continued from page 79)

just outside a small city. I do not know, whether his has been a life of distinction or not, but if loyalty and fidelity and honesty and conscientious discharge of duty enter into the making of success, then by such a standard John Evans has succeeded beyond most of the men of my acquaintance.

I further conclude from the life of Evans that a public utility which has an organization of men and women with something of his conception of duty possesses an asset which belongs in the "invisible balance sheet." Buildings and wires and meters and things terrestrial which can be handled and seen do not of themselves make a utility; the spirit of the business has an asset which defies arithmetic, because there is no way of measuring its value except by its loss.

Assets and Liabilities

This is the end of the moralizing part of my article. The "invisible balance sheet"—in my opinion all directors of public relations should be certified public accountants, relieved, however, from the limitations of figures and qualified to deal with those values which elude the property balance sheet. I would require such directors to keep a balance sheet, constantly revised, and with an understanding that no item in the liability side has there a permanent abiding place; it is to be lifted to the asset side at the first opportunity.

Especially I would not require the "invisible balance sheet" to balance exactly, assets against liabilities, which is the chief obsession of accountants who make the property balance sheet. In the "invisible balance sheet," when there is a balance something is wrong. And finally I would not expect a utility to build up the asset side of its "invisible balance sheet" by large money expenditures, for we were long ago told that the things of the spirit cannot be bought with money.

But good judgment, common sense, tact and unfailing and sincere courtesy, thoughtful consideration for the people we serve and for the men and women who help us serve—these are the expenditures, this the legal tender which effects changes in the "invisible balance sheet."

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LETTERS TO THE EDITOR

Residential Gas Usage

To the Editor of ELECTRICAL WORLD:

I have just finished reading my ELECTRICAL WORLD of January 1, 1949 and wish to compliment Mr. H. F. G. Main for his excellent, informative and forthright article *Complexity To Simplicity In Rates Without Complaints.*

The policy outlined in the paragraph on residential water heating, page 45, must have been as disappointing to folks planning "All Electric" homes as it was distressing to me, particularly the statement "The rate of 1.6¢ per kwhr for water heating will no doubt curtail a very desirable load. . . ." Though there may have been no complaints about the increase in rates, the research department of the gas company probably danced in glee when they learned of the decision to raise the bottom step of the residential electric rate from 1.5¢ to 1.6¢ rather than to reduce it to 1.0¢ per kwhr. I can imagine the gas people exclaiming "Good old PEPCO, the best salesman we ever had, again has come through for dear old EAR on gas house heating, gas water heating, gas cooking, gas refrigeration—and electric lighting."

Perhaps we conservative Easterners should cast our eyes westward to progressive "Electrical West" and heed the words of wisdom editorialized January, 1948, on the subject *If we Stay in Business* as follows:

"If the electric power industry never had competition before, it has it now. LP gas is riding this crisis in electric power to intrench itself as deeply as the storage tank it sells the customer. It will be harder to blast it out. Every customer it takes over for the cooking and water heating load costs electric utilities more to serve for lights alone. . . . If we intend to stay in business, we cannot escape being the foremost exponents of the virtues of electrified living, electrified farming and electrified manufacturing. This is the essential justification for being in business at all. . . ."

Utilities on the Pacific Coast, such as Pacific Gas & Electric Company, are in

San Francisco

Kwhr		Rate	Bill
First	40	3.9¢	$1.56
Next	60	2.1¢	1.26
Next	100	1.7¢	1.70
Excess of	200	1.0¢	
Total for	200		$4.52

Washington

Kwhr		Rate	Bill
First	20	4.0¢	$ .80
Next	20	4.0¢	.80
Next	160	1.9¢	3.04
Excess of	200	1.6¢	
Total for	200		$4.64

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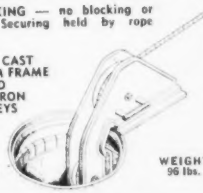

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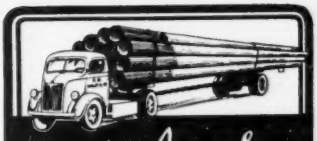

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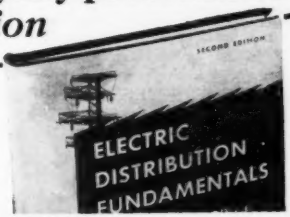

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252 pages, 163 figures, 15 tables, $3.50

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there pitching for electric water heating and are even taking on electric house heating at 1.0¢ per kwhr. What has San Francisco (population 634,536) got that Washington (population 663,091) doesn't have? I would say, promotional residential electrical rates which will give gas some competition.

With such electric house-heating equipment on the market as United States Rubber Co's "Uskon" house-heating panels; Continental Radiant Glass Heating Corp's radiant glass home-heating panels; Electradiant Corp's low-voltage, high-current radiant heating system; Wesix Electric Heater Co's wireheat automatic electric space heating system; Westinghouse Electric Corp's Adjust-o-Matic electric home-heating equipment; Electric Air Heater Co's Electromode all electric heaters, and with other prominent manufacturers moving into the electric home-heating field, isn't it about time that PEPCO take electric house heating seriously and adopt 1¢ per kwhr as the promotional step for all-electric residential rates?

Opportunity Missed

The mere fact that the regulatory commission rejected PEPCO's proposed rate for water heating as being discriminatory does not justify a defeatist attitude with respect to exploring other types of promotional rates—such decisions do however, provide a way out for the electric utility if it is so inclined. Apparently PEPCO passed up a splendid opportunity to place itself in an enviable position by the adoption of a single promotional residential rate. If PEPCO is to be a leader in utility business, it will be on its record of residential and not commercial or industrial rates. A large use of electric energy in the home affects a lot of people. On the other hand, the cost of electric power in a commercial or industrial establishment is a comparatively small part of the cost of doing business.

The electric boys should not forget that the gas boys first sell gas house heating then follow with such "come on" items as gas water heating, gas cooking, gas refrigeration, and may in time—if the electric utilities remain apathetic regarding large residential energy use—again sell gas lighting! A fact not to be overlooked if one is to stay in business!

E. T. Hughes
Arlington, Va.

(Being an engineer on the FPC staff, Mr. Hughes wishes to make it clear that "Opinions expressed herein are the author's own and have been neither approved nor disapproved by the Federal Power Commission.")

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT : "OPPORTUNITIES" : EQUIPMENT
BUSINESS : : (Used or Resale)

UNDISPLAYED —RATES— DISPLAYED

(Not available for equipment advertising)

$1.20 a line, minimum 4 lines. To figure advance payment count 5 average words as a line.

Individual Employment Wanted advertising rate is ½ the above rates payable in advance.

Box Numbers—Care of publication New York, Chicago or San Francisco offices as one line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is $9.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

WANTED: ENGINEERING graduate with some power plant experience to train for position as assistant boiler house superintendent in large industrial plant. P 7892, Electrical World.

EMPLOYMENT SERVICE

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (39 years recognized standing and reputation). The procedure is highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present positions protected. Send only name and address for details. R. W. Bixby, Inc., 262 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

YOUNG E.E. seeks sales engineering opening. Has degree plus 3 yrs. pwr. plant and refinery elec. design-drafting exp. Also interested in Jr. EE., Engineering Aide, or Safety Engineering openings. Free to travel. PW-7795, Electrical World.

PROTECTION AND control engineer. Twenty-two years in and out office of large power company. Experienced: application maintenance and operation of relays, automatic controls, simplified carrier current pilot relaying. Supervision installation of relays, controls and switchboard wiring. PW 8087, Electrical World.

ELECTRICAL ENGINEER, age 43, excellent health, wide experience in testing, inspecting, design and construction of power plants, industrial plants, substations, switch boards, automatic controls, power and lighting distribution and Hi-tension relaying. PW 8151, Electrical World.

ELECTRICAL ENGINEER with M.S. in illumination. 14 years responsible engineering experience in generation, transmission and distribution with utility company. PW 8125, Electrical World.

SELLING OPPORTUNITIES WANTED

OLD ESTABLISHED agency desires additional lines including insulators and transformers for Kansas City trade area. RA 7878, Electrical World.

CORNELL GRADUATE Engineer—Desires engineering products to sell in Indiana territory on straight commission basis. RA 8154, Electrical World.

SALES MANAGER
AVAILABLE

Equipment sales experience. Wide national contacts with utility purchasing & engineering officials. Excellent background.

PW-8126, Electrical World
520 North Michigan Ave., Chicago 11, Ill.

Electrical Meter Engineering
"The Profession With a Future"

Meter Department demands are bringing good opportunities to meter experts.
HOME STUDY COURSE
Practical up-to-date home study covers all phases of Meter Work
Write Today for Free Booklet
Fort Wayne Correspondence School
Dept. 12-B, 201 Dime Bk. Bldg. Fort Wayne 2, Ind.

WANTED
MAINTENANCE
AND
CONSTRUCTION ENGINEER

With wide experience in maintenance and construction of overhead and underground distribution and transmission lines. Must be capable of assuming full responsibility. Permanent position with large rapidly growing Eastern Utility. Give details of education, experience and salary desired.

P-7701, Electrical World
330 West 42nd Street, New York 18, N. Y.

WANTED
STEAM PLANT SUPERINTENDENT

To operate new 15,000 kw 600 psi 825° F. steam plant near Humboldt, Iowa. To be responsible for operation and maintenance of all plant equipment and personnel. Write giving full particulars of education, experience, references, and salary expected.

CORN BELT POWER COOPERATIVE
Humboldt, Iowa

ENGINEERING EXECUTIVE

A man who can handle a top engineering, sales and administrative position with a well-established contracting engineering organization serving both small and large industrial and commercial firms in New York Area.
Experienced in estimating and supervising electrical construction work, as for example in industrial plant maintenance and expansion, in new building construction, or in the public utility field.
E.E. degree, or M.E. degree with electrical experience. Age 30 to 45.
Write qualifications and past experience.

P 8170 Electrical World
330 West 42nd St., New York 18, N. Y.

ELECTRICAL ENGINEERS

Graduates, experienced in design, engineering and economic studies of steam-electric power plants and high voltage substations. Also, engineer experienced in power system relaying and in preparation of specifications for switchboards and switchgear. Please submit resume including personal data, education and experience record to

P 8078, Electrical World
330 West 42nd St., New York 18, N. Y.

GOVERNMENT OF VICTORIA

CHAIRMAN

State Electricity Commission of Victoria

Applications are invited for the position of Chairman of the State Electricity Commission of Victoria. The present salary allowed under the Act is £3,000 (Australian), but the Government proposes to amend the Act next Session to increase the maximum salary to £6,000 (Australian).

Each applicant is required to state his qualifications, experience and age. The term of appointment will be for a period not exceeding seven years, with the right to apply for re-appointment at the end of the term. The successful applicant will be required to devote his whole time to the service of the Commission, and must not engage in any employment other than in connection with the duties of his office.

The Commission was formed in 1919, and is a statutory body functioning under Act of Parliament. It consists of four Commissioners, of whom three serve in a part-time capacity. The selected appointee will be the executive head of the undertaking.

The Commission operates a State-wide system of power stations, transmission lines and distribution networks, and supplies 98 per cent. of the electricity generated in Victoria. The principal steam station is at Yallourn, and it uses raw brown coal won by open cut methods from extensive adjacent deposits operated by the Commission. Other steam stations use brown coal briquettes manufactured by the Commission at its Yallourn briquette factory. There are hydro-electric stations at Kiewa and elsewhere. The installed capacity of the generating system is 454 megawatts, and it is planned to be increased to over 900 megawatts in the next decade.

An extensive construction programme, involving the expenditure of several million pounds per annum for many years, is now in hand, including the enlargement of the Kiewa scheme, extensions of the Yallourn and other power stations, and a major expansion of the briquetting industry based on a new open cut at Morwell. The existing assets of the Commission are valued at over £40 million; its present revenue is about £7 million per annum. It employs nearly 13,000 persons.

Additional information regarding its activities may be obtained on application to the undersigned, or to the Agent-General for Victoria, Victoria House, Melbourne Place, The Strand, London or the Australian Consulate-General, International Buildings, Rockefeller Centre, 636 Fifth Avenue, New York.

Applications, accompanied by copies of references, should be submitted in writing to the Minister-in-Charge of Electrical Undertakings, 13-45 Spencer Street, Melbourne, C.1., not later than 18th April, 1949.

(sgd.) W. S. KENT HUGHES,
Minister-in-Charge
of Electrical Undertakings

Wanted
Design Engineer

Experienced in design and detailing of electric power substations. Duties consist of layout and detail design of substations, including steel structures and checking detail drawings. Salary open.

Write Personnel Director.

SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA
Give full details in the first letter.

WANTED
Design Engineer

Experienced in design and detailing of electric switch-gear. Duties consist of preparing layout and shop detail drawings. Salary open.

Write Personnel Director

SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA
Giving full details in the first letter.

WANTED

TRANSMISSION SUPERINTENDENT

To operate and supervise 600 miles of new 69 kv transmission line, 30 substations, maintenance crews and equipment. Electrical degree and actual previous transmission and substation experience preferred. Write giving full particulars of education, experience and references.

CORN BELT POWER COOPERATIVE
Humboldt, Iowa

PROTECTION ENGINEER
WANTED

With experience in application and maintenance of transmission, distribution and generating station relaying including fuse coordination. Must be capable of reorganizing and taking complete charge of relay section. Excellent opportunity for permanent position with large growing utility company. Reply giving age, education and experience. All replies confidential.

P 7895 Electrical World
330 West 42nd St., New York 18, N. Y.

MECHANICAL ENGINEERS
For Positions of
Project and Senior Engineers
Steam Power Plant and/or Gas Plant Experience Preferred. Ideal Community—Close to Metropolitan Areas. Write to
Mechanical Engineer
PENNSYLVANIA POWER & LIGHT CO.
Allentown, Pa.

DISTRIBUTOR WANTED

Established national distributor to handle on exclusive basis, Pole Line Hardware for high power transmission lines. This is a highly acceptable product to transmission line authorities.

RW-7876, Electrical World
330 West 42nd Street, New York 18, N. Y.

Do your TRANSFORMERS *need* REBUILDING?

Your transformers will need repairing or rebuilding. The entire facilities of THE OHIO TRANSFORMER CORPORATION are at your command and these facilities, together with skilled personnel, assure you of complete satisfaction and prompt service.

Have you TRANSFORMERS *that you want to* SELL?

Your transformers which are no longer required are of interest to us. To supplement our stock, we need your transformers. Please tell us what you have for sale.

THE OHIO TRANSFORMER CORPORATION
Court & Harriet Sts. CINCINNATI 3, O.

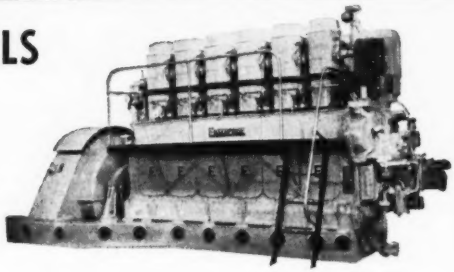
NEW ENTERPRISE DIESELS

WITH 300 KW IDEAL A.C. GENERATORS

FOR

IMMEDIATE DELIVERY

OTHER DIESELS AVAILABLE
UNIT CAPACITIES—10 TO 1420 KVA
A.C.—50 AND 60 CYCLES



A PARTIAL LIST OF OUR INVENTORY

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1420	Fairbanks Morse	38D8⅛	1600	720	312	General Motors	8-268A	450	1200
1250	General Motors	16-278A	1600	720	300	Fairbanks Morse	YVA	360	257
900	General Motors	12-567	1080	720	200	Buckeye	80	240	600
625	Superior	OS	750	327	125	General Motors	3-268A	150	1200
425	Baldwin	VO-6	510	450	75	General Motors	6016-E	90	1200
375	Enterprise	DSG-6	450	450	62	Int'l Harvester	UD-18	76	1200

WRITE FOR COMPLETE INFORMATION

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc.

ESTABLISHED 1898

Diesel Engines • Power Machinery

ENGINE DIVISION, 50 CHURCH STREET, NEW YORK 7, N. Y.

J. L. HEMPHILL & CO.

ELECTRICAL ENGINEERS & EQUIPMENT

1606 53rd ST. NORTH BERGEN, N. J. N.Y.C. Tel. LOngacre 5-3227 N. J. Tel. UNion 3-7600

MOTOR SQ. CAGE

1—450 HP.—Ridgeway 900 rpm 2200v.
1—125 HP. G.E., 1800 rpm 2300v.
1—100 HP. Whse, 1800 rpm 440v.
1—100 HP. Whse, 1200 rpm 2200-440v.
1— 75 HP. Whse, CS, 1200 rpm, 2200 volts, 3 phase, 60 cycle.
1—75 HP. 1800 rpm Westinghouse, 440 volt.
1—75 HP General Electric Type KT 900 RPM 440 volt.
3—40 HP. G.E., 900 rpm 220v.

MOTORS SLIP RING

1—2500 HP G.E. MT 257 RPM 4600 volt
2— 150 HP G.E. Type IM 450 RPM 440 volt.
1— 100 HP G.E. Type IM 400 RPM 440 volt.
1—100 HP. G.E. 720 rpm 440v, 25 cy. IM.
75 HP. G.E. 1200 rpm 220v, 60 cy. Vert.
60 HP. West. 900 rpm 2200v. 60 cy. Vert.
50 HP. F.&M. 1800 rpm 220v. 60 cy.

MOTORS—D. C. 230 VOLTS

1—125 HP. G.E. 1800 rpm R.C.
1— 75 HP. 865 rpm General Electric.
1— 50 HP. 700 rpm Crocker-Wheeler.

VARIABLE SPEED 220 VOLTS

1—35 HP. 300/1200 rpm Westinghouse.
1—30 HP. 440/1200 rpm General Electric.
2—25 HP. 650/2200 rpm Westinghouse.
2—25 HP. 300/900 rpm Electric Dynamic.
1—55 HP. 500/1500 rpm General Electric.

MOTOR GEN. SETS

1—1000 KW Westinghouse 275 volt, 720 RPM 4000 volt Syn.
1—1000 KW General Electric 600 volt 514 RPM 4000 Volt Syn.
1—500 KW. G.E. 250v 900 rpm 2300v Syn.
1—500 KW. G.E. 575v 900 rpm 2300v Syn.

1—125 KW. Crocker Wheeler 1200 rpm 125v Generator 2200v S.C. Motor.
1—100 KW. Elect. Mach. 1200 rpm 125v Generator 4150 Syn. Motor.

PLATING GENERATORS

1—1½ KW. G.E. 5/9v with sq. cage mt.
1—12 KW. Hansen Van Winkle 24v 1200 rpm. 20 HP. General Electric KF Motor.
1—3000 Amp. Chandeysson, 6/12v 400 rpm Syn. Motor.
1—2500 Amp. ditto.
1—625 KVA West. Reduction Gear Turbo Generator Non-Condensing, 2400v 3 ph 60 cy.

TRANSFORMERS

1—1000 KVA G.E. 3 ph. 4150 volt to 2400 volt.
1—667 KVA General Electric, 3 phase 4150 volt to 2400 volt Auto.
3—300 KVA Pitts. 2300v prl. 115/230v sec.
3—300 KVA G.E. type H 2300v prl. 115/230v sec.
3—150 KVA West. 2300 volt Prl. 240/480 sec.
1—150 KVA G.E. 2300v 110-220v.
2—100 KVA type SK, 13,200v primary 250v, secondary single phase.
10—27½ KVA G.E. 1 ph. brand new 440/220v 220-110v.

ALTERNATORS & SYNCH. MOTORS

1—2500 KVA Westinghouse, Syn. condenser. 720 rpm 2200v with D.C. exciter.
1—320 KVA Allis Chalmers, 450 rpm 480v.
1—240 KVA General Electric ATB, 600 rpm 240v with D.C. exciter.
1—225 KVA 514 rpm 600v Westinghouse.
4—200/100 HP. Whse. 720/360 rpm 4150v.
1—200 HP General Electric 257 RPM 440 volt.
1—165 KW. 514 rpm 2200v Electric Machinery.
1—100 HP. G.E. type TS 800 rpm 4400v D.C.
2—150 HP Allis Chalmers, 360 RPM, 2200 volt

Complete Line of A.C. and D.C. Motors and Generators

TURBO GENERATORS

TURBINE OF THE MONTH

1—750 KW-GE 250 lbs. cond., 3 ph. 60 cy. 40, direct conn. Exciter, Surface Condenser. Built 1944.

1—5000 KW 6250 KVA, G.E. 3600 RPM 175/200 lbs. I.SP. 100° S.H. Condensing 3 ph. 60 cy 2300/4000v. Surface Cond. & Aux.
1—2000 KW G.E. 6600c, 3 ph., 60 cy. with 175 lb. cond. turbine and dir conn. exciter
1—1500 KW G.E. 2300v, 3 ph., 60 cy. with G.E. 225 lbs cond turbine, surface condenser
2—1250 KW GE. 2300v, 3 ph., 60 cy. with 175 lbs. condensing turbine
1—1250 KW Al Ch. 2300v, 3 ph., 60 cy. with 200 lb. condensing turbine, surface condenser
1—1000 KW G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine

BELYEA COMPANY INC.
51 Howell St. Jersey City 6, N. J.
Phone—Journal Square 2-3334
ALSO N. Y. CITY LINE—RECTOR 2-7150

FOR SALE

One 1,000 KW G.E. turbo unit incl. condenser, auxiliaries, foundation plans—being replaced by larger unit.
750 KW Whse. turbo unit
Two 2000 gpm motor-driven pumps
10,000 #/hr. Deaerating Heater

ROOM 4200, 141 W. JACKSON BLVD.
CHICAGO, ILLINOIS

METERS FOR SALE

Graphic demand meters, Lincoln, type CCW, 120 volt, 5 amp. Watthour meters, G.E. types I-14 and I-16; Westinghouse type OB; Sangamo type H. All 110 volt, 5 amps., 2 wire. All equipment used but in good operating condition.

ELLMANN COMPANY
CHANDLER BLDG. WASHINGTON 5, D. C.

FOR SALE

USED RUBBER GLOVES

Tested at 10,000 volts and in good condition, 200 pairs available—sizes 9 to 11.

MISSOURI PUBLIC SERVICE CORP.
Hout Bldg. Warrensburg, Mo.

FOR SALE—EXCITER

1—100 KW G.E. Exciter, 125 volts, 800 amps., 1200 R.P.M., compound wound driven through a reduction gear by a DeLaval Steam Turbine designed for 150 lb. dry saturated steam and exhaust against 5 lb. g. back pressure. 5400 R.P.M. Exciter, reduction gear and turbine mounted as a unit on a cast iron bed plate.

FS-7839, Electrical World
530 West 42nd Street, New York 18, N. Y.

"SUCCESSFUL OPERATION GUARANTEED" Belyea

We Rebuild in accordance with N.I.S.A. Standards

D. C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1750	Whse.		600	550/700
6	1500	Whse.		525	600
1	1200	Whse.		600	525/700
1	700	G.E.	MCF	600	150/525
1	650	G.E.	MPC	250	115/145
1	600	Whse.		600	800/950
2	600	G.E.	MPC	600	600/720
1	335	Whse.	MQ	250	300/900
1	200/300	G.E.	MPC	220	360/920
1	275	Whse.	QM-600 6	230	425/850
1	250	G.E.	MPC	230	400/800
1	230	Al. Ch.		230	700
3	150	Whse.	SK-200	230	600
1	150	Cr. Wh.	CMC-65H	230	1150
1	150	G.E.	MPC	230	230/450
1	150	Cr. Wh.	152HL	230	300/1050
3	150	Cr. Wh.	TEFC-87H	230	800
1	150	G.E.	CD-B-Brg.	600	250/750
2	125	G.E.	CO	220	625
1	125	El. Dy.	308	230	750/1660
1	115	Cr. Wh.	JHL	230	1200
1	100	G.E.	CD-175	230	365/730
1	100	G.E.	MPC	230	225/450
3	100	Whse.	SK-Vert.	230	485/950
2	100	Rel.	1050T	230	400/1200
1	80	El. Dy.	308	230	475/950
3	75	Cr. Wh.	53H-TEFC	220	860
1	75	Whse.	SK-180	125	650
1	75	G.E.	Sprague C	230	500/1000
2	75	G.E.	CDM-1126Y	230	2000

TURBO GENERATOR SETS

See ad on page 156

SYNCHRONOUS CONDENSERS

Qu	KVA	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
	4000	G.E.	TSC	2400/4150	900
	3000	Whse.		2400	720
	3000	G.E.	ATI	4800	720

MOTOR GENERATOR SETS

3 Ph. 60 Cycle

Qu.	KW	Make	Speed	DC Volts	AC Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	360	275	2200/4400
1	1500	G.E.	600	600	4150
1	1500	Whse.	600	600	4150
1	1250	G.E.	600	275	2300/4150
1	1000	Whse.	900	600	2400/4160
1	1000	Whse.	514	250	4000
1	1000	Whse.	514	600	4000
1	800	SUGH	1200	240	2300
1	750	Cr. Wh.	720	250	2300/4160
1	750	Whse.	720	250	2400/4160
1	500	G.E.	720	125	2300/4150
1	500	G.E.	720	600	4400
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	4150
1	150	Cr. Wh.	1200	250	220/440
1	100	G.E.	1170	125	220/440
1	100	G.E.	1200	250	2200
1	175	C.R.W.H.	1170	250	440

ROTARY CONVERTERS (60 cycle)

Qu.	KW	Make	Speed	DC Volts	AC Volts
1	2000	G.E.	514	600	13200
1	2000	G.E.	450	600	13200
1	1000	Whse.	900	600	11000
1	750	Whse.	900	600	13200
1	500	Whse.	900	250	6600

All units can be furnished with AC and DC Control

MERCURY ARC RECTIFIERS

1	1000	Al. Chal.	B-612	625	13500
*1	1000	B-B	25/60 cy.	625	6600/13200
1	750	G.E.	RHW	575	*2300/4000

*Complete with full automatic A.C. and D.C. controls

A. C. MOTORS—3 Ph. 60 Cycle

Synchronous

Qu.	HP	Make	Type	Volts	Speed
2	3500	G.E.	TS	2300	257
1	2100	G.E.	ATI	4600	514
2	2000	Whse.		2200	120
1	1000	Whse.	MILL	2300	189.5
2	900	Al. Ch.	Eng. (new)	2200	150
1	600	Whse.		440	360
1	500	G.E.	ATI	4800	900
2	500	G.E.	TS-9832	4160	600
1	450	Whse.		2200	428.5
2	350	G.E.	TS	2200	180
1	320	G.E.	ATI	2300	600
1	308	Al. Ch.		440	600
1	300	G.E.	ATI	440	720
1	300	Whse.	Enc.	2300	720

Slip Ring

1	1000	Whse.	CW	2300	705
2	700	Whse.	CW	2200	900
1	500	G.E.	IP	550	505
3	450	G.E.	IM	440	505
1	500	G.E.	MIII-IM	2200	450
1	400	G.E.	IM	2200	252
3	350	Whse.	CW	2200	900
1	350	G.E.	MT-442y	4000/2300	257
1	300	Al. Ch.	ANY	2300	505
1	250	G.E.	MT	4000	257
1	250	G.E.	MT-559S	2200	750
1	250	G.E.	MT-563y	550	900
1	135	G.E.	IM	2300	700
2	100	G.E.	IM-16	2200	435

Squirrel Cage

1	250	G.E.	KT-559	440	1750
1	250	G.E.	IK	2200	600
1	200	G.E.	KT-557	440	1800
1	200	G.E.	IK	550	865
1	125	w/ G.E.	KF TEFC	440	1190
1	125	G.E.	KF-6328L	440	3585
2	100	G.E.	KT-543	220/440	1750
1	100	G.E.	IK	440	575

Every Machine Is Owned Outright by Us

RE NU BILT BELYEA MOTORS

Belyea COMPANY, INC.

MAIN OFFICE AND SHOP
51 HOWELL ST., JERSEY CITY, N. J.

What are your needs?
UNITS UP TO 5000 KW
AVAILABLE IN STOCK

FOR SALE
GOULD KATHANODE STORAGE BATTERY
with single tier steel rack
Type OSX 23—59 Cell
Amp. hr. cap. 8 hr. rate disch. 836.
Used floating on line in parallel with generator.
Installed July 1947. Available April 1st.
WILLIAM FRASER, Ch. Engr.
YMCA 215 W. 23 St., New York, 11, N. Y.
Phone: CHelsea 3-1982

WANTED

METERS WANTED

500—15 ampere, 3 wire, 60 cycle
25—80 ampere, 3 wire, 60 cycle
1500—15 ampere, 2 wire, 60 cycle
75—15 ampere, 3 phase, 4 wire, 120/208 volt
Give complete data, and prices.

ELLMANN COMPANY
CHANDLER BLDG. WASHINGTON 5, D. C.

WANTED

Water softening and demineralizing equipment metal-clad switch gear, 19000/2300 V power transformers.

Room 4200, 141 W. Jackson Blvd.
Chicago, Illinois

NEW "SEARCHLIGHT" ADVERTISEMENTS
received by 10:00 A.M. March 4th will appear in the March 12th issue, subject to space limitations.

Classified Advertising Division
ELECTRICAL WORLD
330 W. 42nd St., New York 18, N. Y.

DIESEL GENERATOR UNITS

IN STOCK—IMMEDIATE SHIPMENT

2—1420 KVA—FAIRBANKS MORSE—NEW ALTERNATORS DIRECT CONNECTED TO FAIRBANKS MORSE MODEL 38D8-1/8 1600 HP—720 RPM—DIESEL ENGINES.

2—1250 KVA—CROCKER WHEELER—NEW ALTERNATORS DIRECT CONNECTED TO FAIRBANKS MORSE MODEL 38D8-1/8 1600 HP—720 RPM—DIESEL ENGINES.

2— 620 KW—240 VOLT—DC GENERAL ELECTRIC GENERATORS DIRECT CONNECTED TO ALCO TYPE 6—12½ X 13-T 900 HP—700 RPM DIESEL ENGINES.

ENGINES NEW LATE 1944—RELATIVELY FEW HOURS OPERATION

WALTER H. WILMS & COMPANY

2526 GUARDIAN BUILDING, DETROIT 26, MICHIGAN
WOODWARD 1-1856—1-1857

FOR SALE

MUNICIPAL PLANT

FAIRBANKS-MORSE DIESEL ELECTRIC,
WHOLE OR PART. Good Condition.

1-300, 1-155, 1-72 KW, 3 ph. 60 c. 2400 v. Gen., switchboards, pumps, filters, softener, cooling tower, mufflers, piping.

For Owner

Benj. W. Bissell, Engr.
531 K. P. Bldg. Indianapolis, Ind.

Power Equipment

Released by Utilities & Industrials

Turbines, Generators, Steam and Oil Engines, Boilers, Motor Generators, Rotaries, Transformers, Motors, Compressors, Induction Voltage Regulators, Oil Circuit Breakers, etc.

Service backed by 40 years' experience

BREW, WOLTMAN & CO.

32 Church St., New York 7, N. Y.

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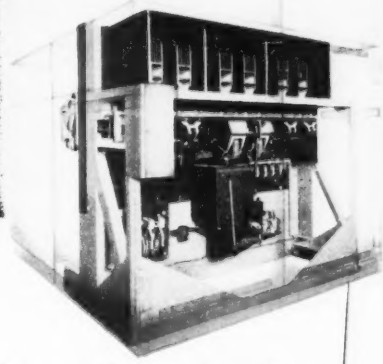
A 6000-AMPERE TRUCK-MOUNTED DRAW-OUT TYPE CIRCUIT BREAKER

for Main-, Bus-Tie-, and Feeder-Breaker Applications

Another I-T-E "first"!



AGAIN I-T-E LEADS the way in Switchgear design! The new I-T-E LG Circuit Breaker is the first 6000-Amp. breaker to be offered in a truck-mounted, draw-out type.

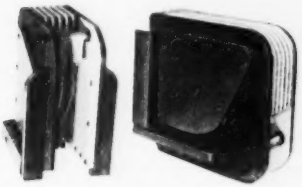
The rugged, heavy-duty Type LG is the ideal breaker for applications where breaker operations are relatively few, and where high interrupting ability — with moderate operating speed — is needed. The LG is designed and built to carry a full load continuously for long periods of time with a minimum of temperature rise.

I-T-E's Truck-Mounted Draw-Out Type LG Circuit Breaker is another example of I-T-E leadership in producing custom-made circuit breakers and switchgear equipment to meet the exacting requirements of individual customers. It is exclusively an I-T-E product — designed and built where Switchgear is a business, not a side line.

The I-T-E representative in your locality will be glad to assist and advise you on adapting the new truck-mounted LG breaker to your electrical distribution system. Use his services without obligation. For complete technical and application data, write for LG (Catalog) 1104.

CONSTRUCTION FEATURES OF THE I-T-E TYPE LG CIRCUIT BREAKER

MAIN CONTACTS are built up of copper bars with silver alloy inserts to provide silver-to-silver contact. Silver facings are durable — more than 40,000 openings and closings do not cause perceptible wear of the contact faces. Intermediate and arcing contacts protect main contacts during opening and closing operations.



ARC CHUTES are magnetic blow-out type. Magnetic vanes, mounted outside the insulating barriers on each side of the contacts, are magnetized upon opening of the intermediate contacts, and the resulting magnetic field forces the arc into the extinguishing chamber. Arcing time is short, arc is completely confined, heavy currents are safely handled in small space.

CONTROL MECHANISM is centrally located. A small door in the main enclosure panel gives access to controls. Actual mechanism is so designed that it automatically locks the truck when in *Disconnected, Test,* or *Operating* position. The truck can be moved to any of these positions without opening the main compartment doors, thus complete protection is given to the operator and the mechanism. An interlocking mechanism prevents the truck from being moved into or out of the operating position unless the breaker has been tripped and all contacts opened.

APPLICATION RATINGS—TYPE LG CIRCUIT BREAKERS

	PANTOGRAPH-MOUNTED	TRUCK-MOUNTED
600 V AC	2000-3000 A	4000-6000 A
250 V DC	2000-5000 A	6000-10,000 A

2-, 3-, and 4-Pole. Electrically operated.
75,000 and 100,000 amperes R.M.S. Interrupting Rating.

I-T-E R&IE *

The Leader In Technical Excellence

I-T-E CIRCUIT BREAKER COMPANY, 19th & HAMILTON STREETS, PHILADELPHIA 30, PA.

31 OFFICES IN UNITED STATES • In Canada, EASTERN POWER DEVICES, Ltd., TORONTO

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • AUTOMATIC RECLOSING CIRCUIT BREAKERS

*FOR POWER SWITCHING EQUIPMENT, REFER TO RAILWAY AND INDUSTRIAL ENGINEERING CO., AN I-T-E ORGANIZATION

External view L.V. side of Distribution Transformer, 150 KVA, single phase, 60 cycle, OISC 33,000-7620 volts.

There's a difference in making something to last ten years, and making something to last! In Kuhlman Transformers, every coil of wire, every piece of metal, every coat of paint is designed and applied to last — and last! They aren't made to last for stated periods of time — but to give service — as far into the future as man and materials can contrive. That's why Kuhlman Transformers have a reputation for utmost dependability. Kuhlman Transformers are built for service — continued service.

KUHLMAN ELECTRIC COMPANY

BAY CITY, MICHIGAN

EXPORT REPRESENTATIVES: *International Standard Electric Corporation,* 67 Broad St., N. Y. 4, N. Y. Cable Address: Microphone, N. Y.

TRANSFORMER TOPICS *by* KUHLMAN

QUESTION:

Two single phase transformers are to be operated in parallel. Characteristics of the two transformers are as follows:

	No. 1	No. 2
Kva	100	200
Voltage	6900/230	6900/230
% IR	1.25	1.34
% I_X	5.49	5.53

(a) At a total load of 300 Kva, 0.8 P.F. lagging, determine the Kva and current supplied by each transformer.

(b) What is the maximum total load at this power factor which will not overload either transformer?

ANSWER:

(a) Constants for Transformer No. 1

$$I = \frac{100 \times 1000}{230} = 435 \text{ amperes.}$$

$$R_e = \frac{.0125 \times 230}{435} = .00662 \text{ ohms.}$$

$$X_e = \frac{.0549 \times 230}{435} = .0290 \text{ ohms.}$$

$$Z_1 = .00662 + j\,.0290 = .0296 \text{ ohms.}$$

Constants for Transformer No. 2

$$I = \frac{200 \times 1000}{230} = 870 \text{ amperes.}$$

$$R_e = \frac{.0134 \times 230}{870} = .00355 \text{ ohms.}$$

$$X_e = \frac{.0553 \times 230}{870} = 0.0146 \text{ ohms.}$$

$$Z_2 = .00355 + j0.0146 = .0150 \text{ ohms.}$$

$$I_t = \frac{300 \times 1000}{230} = 1310 \text{ amperes.}$$

Current supplied by Transformer No. 1

$$I_1 = \frac{Z_2}{Z_1 + Z_2} \times I_t = \frac{.0150}{.0296 + .0150} \times 1310 = \mathbf{440 \text{ amperes}}$$

$$KVA_1 = 440 \times 230 \times 10^{-3} = \mathbf{101.2 \text{ Kva}}$$

Current supplied by Transformer No. 2

$$I_2 = \frac{.0296}{.0446} \times 1310 = \mathbf{870 \text{ amperes}}$$

$$KVA_2 = 230 \times 870 \times 10^{-3} = \mathbf{200 \text{ Kva}}$$

(b) $\frac{I_1}{I_2} = \frac{Z_2}{Z_1} = \frac{.0150}{.0296}$

$\frac{I_2}{I_1} = \frac{.0296}{.0150} = 1.973$

$\frac{KVA_1}{KVA_2} = 1.973$ or

$KVA_1 = 1.973\ KVA_2$

$KVA_1 + KVA_2 = 100 + 200 = 300$

$2.973\ KVA_2 = 300$

$KVA_2 = 101$ KVA

or practically, the present 300 Kva total load can be carried.